A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1935.

GENERAL PHYSICS.

ADSORPTION.

3201. Adsorption Theories. A. Ganguli. *Kolloid Zeits.* 71. *pp.* 275–279, *June*, 1935.—Three kinds of adsorption are recognised, *viz.*, van der Waals adsorption, activated adsorption and diffusion by Smekal processes. Experimental results are now discussed in connection with the nature of the adsorbing surface before and during adsorption, and with the nature of the adsorbing substance and the energy of adsorption The merits of the most important adsorption theories are examined, absorption formulæ which introduced oscillation are derived, and the temperature effect is explained. Adsorption measurement per unit of active surface is recommended for the tracing of the adsorption isotherms. Earlier quantum-mechanical theories are discussed and the different physical and chemical theories are thereby united. H. H. Ho.

3202. Adsorption of Alkali Metals on Metal Surfaces. Parts IV and V. J. H. de Boer and C. F. Veenemans. *Physica*, 2. pp. 521–534, *June*, 1935. *In English.*—Further investigation [see Abstract 1 (1935)] of the adsorption of alkali atoms on metal surfaces. Adsorption in the form of ions is limited by the back potential set up: further adsorption takes place in the form of atoms. From energy considerations the atoms must be adsorbed in the neighbourhood of the ions owing to the dipole moment produced. As many as four atoms may be grouped around each ion and the arrangement of the atoms is polarised in such a way as to reduce the work function for the emission of electrons. Increased thickness of adsorbed layer is produced by further adsorption in the atomic form; these atoms, however, are polarised in the reverse direction and raise the surface work function. Investigation of the electron emission under white light with a photoelectric cell shows exponentially increasing emission with increasing thickness of surface layer, a maximum being reached after a certain thickness of atomic adsorption has occurred. Increase of temperature produces an increase in the dipole moment of the adsorbed ions but reduces the induced moment in the atoms. With small thicknesses of Na on W, increase of temperature therefore increases emission but with greater thicknesses a decrease is produced. The effect is quite reproducible if surface migration of the ions is allowed to reach a steady state. F. C. C.

3203. Heat of Wetting. A. Dumanski and M. Tschapek. *Kolloid Zeits.* 71. *pp.* 279–282, *June, and* 72. *pp.* 55–58, *July*, 1935.—In Part I the heats of wetting of powdered charcoal, silica-gel, and permutit have been determined for surfaces which contain various adsorbed kations, *e.g.*, Fe^{III}, Ca^{II}, Mg^{II}, NH_4^{I}, K^{I}, Na^{I} and H^{I}. A part of the heat produced is due to the heat of hydration of the adsorbed ion, whereby the ratio, heat of hydration of ion/heat of wetting of powder, is greater according as the powder is the more hydrophobic. One and the same adsorbed kation influences the heat of wetting differently for different adsorbents. Part II deals with the influence of adsorbed air on the heat of wetting,

and experiments are described for the following evacuated and non-evacuated powdered absorbents; peat, charcoal, silica-gel and soil. Peat is actually wetted first with evolution of heat after removal of adsorbed air, but the increase in heats of wetting for the other materials is insignificant. The increased heating-effect after removal of adsorbed air is explained by the decrease of external work in the wetting process.
H. H. Ho.

3204. Surfaces of Powders and Heats of Wetting. H. Herbst. *Kolloid Zeits.* 71. *pp.* 282–290, *June*, 1935.—In order to determine a surface, it has been assumed hitherto that the ratio of the amount of adsorption at a smooth metallic surface to that for a powder is the same as the metal to the powder surface. It is now shown that this ratio is not exactly valid, and that the ultra-structure and decrease in ultra-porosity exert great influence whereby for different adsorptives, with varying molecular dimensions, quite different surface relationships are obtained for one and the same powder. In consequence the author has devised an apparatus for the direct determination of heats of wetting by oils on smooth metallic surfaces, details of which are given together with experimental results for different lubricating oils. H. H. Ho.

3205. Effect of Temperature on the Adsorption of Electrolytes by Charcoal. L. Lepin and G. Strachowa. *Zeits. f. phys. Chem.* 173. *Abt.A.* 2. *pp.* 129–140, 1935.—Strong electrolytes (HCl and H_2SO_4) show a positive, and weak electrolytes (formic and acetic acids) a negative, temperature coefficient of adsorption to sugar charcoal, over temperature ranges between 0° and 100° C., and adsorption equilibrium is much more rapidly attained in the former than in the latter series of electrolytes. It is inferred that while, with strong acids, the adsorption mechanism is mainly one involving endothermic ionic reactions with the surface oxide film, with weak acids the adsorption is purely molecular. L. V. C.

3206. Ionisation of Hydrogen Gas in Contact with Pt, Cu and Ni. C. Y. Meng, P. A. Anderson and Y. M. Hsieh. *Chinese Chem. Soc., J.* 3. *pp.* 103–114, *June*, 1935. *In English.*—Ionisation of H_2 in contact with Pt, Cu and Ni plates was measured at different temperatures ranging from 30° to 100° C. The ionisation currents were measured in terms of absolute units by means of a standard condenser. It is shown that activation of H_2 after being desorbed from Pt, as observed by many workers, is not due to ionisation of the gas. AUTHORS.

3207. Porosity of Charcoal. A. King. *Faraday Soc., Trans.* 31. *pp.* 935–937, *July*, 1935.—A simple explanation of the porosity of all charcoals, both activated and unactivated, is put forward. When aliphatic organic materials are charred volatile tarry materials containing unsaturated derivatives are evolved, and some probably combine with the carbon owing to the momentary setting free of valencies. Most are probably decomposed later but some are very stable. The part of the surface thus involved is prevented from growing or coalescing with other graphite rings and remains exposed. This inhibition of crystal growth accounts for porosity. Those charcoals which have solidified from the melt should be less porous than those formed when the solid state persists throughout charring. This is experimentally verified. It is proposed to extend this work to other systems of a similar nature. P. H. B.

See also Abstracts **3326, 3328.**

ATOMIC AND MOLECULAR STRUCTURE.

3208. Constitution of Atomic Nuclei and their Magnetic Moments. S. Shimasaki. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 177–188, *June,* 1935. *In English.*—Assumptions are made that a proton or a neutron does not exist freely in the nuclei but only in combined forms of a deuton (D) or a mass three hydrogen nucleus (T), and further that these D and T have a tendency to unite as $2D$ (α-particle) $2T$ or $D + T$. The nuclei of lighter elements before Ni ($Z = 28$) are built principally by the successive additions of an α-particle, and in those of heavier elements $2T$ additions play the principal rôle. On these assumptions plausible explanations of the number of α-particles, the mass-defect curve, the abundance and occurrence of isobares of elements of odd atomic number are given. The calculation of the nuclear magnetic moments with the value $g = 5{\cdot}0$ for a proton, and $g = -3{\cdot}5$ for a neutron shows a good agreement with the experimental values. AUTHOR.

3209. Interaction Between a Neutron and a Proton and the Structure of H^3. L. H. Thomas. *Phys. Rev.* 47. *pp.* 903–909, *June* 15, 1935.—Considering the mass defect of H^2 to arise from the interaction of neutron and proton, calculation is made of the mass defect of H^3 assuming that (1) the force between two neutrons is negligible, (2) the force between the two neutrons and the proton may be compounded in the usual way, (3) the wave function is symmetrical in the position of the two neutrons. Comparison with the observed mass defect of H^3 provides a lower limit to the radius of interaction of neutron and proton and shows the interaction cannot simply arise from a singularity in configuration space. It is concluded that either (1) two neutrons repel each other with appreciable force, (2) the wave function is asymmetrical in the positions of the neutrons, or (3) the interaction between neutron and proton is not confined to distances small compared with 10^{-13} cm. F. C. C.

3210. Nuclear Model. W. V. Houston. *Phys. Rev.* 47. *pp.* 942–946, *June* 15, 1935.—As a rough model the nucleus is regarded as composed of α-particles, protons and neutrons attracting each other with forces proportional to their separations. Assuming constants of reasonable order of magnitude, treatment by ordinary quantum mechanics gives binding energies showing the observed general trends. The instability of Be^8, composed of two α-particles, is attributed to the high zero-point energy of the system, although the system of three α-particles, C^{12}, is stable. The Pauli exclusion principle applied to the neutrons gives a reason for the limited number of observed isotopes. L. A. W.

3211. Capture of Slow Neutrons by a Nucleus. L. Artsimovitch, I. Kurtschatow, L. Miççovskiĭ and P. Palibin. *Comptes Rendus,* 200. *pp.* 2159–2162, *June* 24, 1935.—Neutrons from Rn + Be were passed through various thicknesses (6·2–20·2 cm.) of H_2O and 0·3 mm. Ag or 0·017 gm./cm.² Cd, and the coefficients of absorption and cross-section for capture in Ag or Rh deduced from the radioactivity produced in screens of those metals. This activity in both metals first increases with the thickness of H_2O traversed (up to 12 cm.) and then rapidly decreases. The results do not support the views of Perrin and Elsasser [see Abstract 1306 (1935)], but lead to the conclusion that either (a) slow neutrons are strongly absorbed in H_2O, or (b) the probability of capture is a resonance phenomenon; (a) would imply a cross-section of 10^{-24}–10^{-25}, which is contrary to Chadwick's and Goldberger's results [see Abstract 4371 (1934)], while (*b*) implies the existence of repulsive forces between neutrons and nuclei at comparatively large distances superposed on attractive forces acting at very small distances. C. A. S.

3212. Nuclear Chemistry. S. Flügge and A. Krebs. *Phys. Zeits.* 36. *pp.* 466–480, *July* 1, 1935.—This systematic survey of the subject up to date commences with a brief historical introduction preceding very full discussion of (1) the validity of the energy and impulse principle; (2) fundamental conceptions; (3) experimental methods; (4) nuclear transformation; and (5) artificial radioactivity. Comprehensive tables are included in the paper, which concludes with a Bibliography containing 211 references. H. H. Ho.

3213. Artificial Radioactivity by Neutron Bombardment. E. Fermi. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics. pp.* 75–77, *Physical Society.*—The advantages of neutrons as bombarding particles are pointed out and experiments are described in which radioactive elements are produced by this process. About 40 cases were found, out of 60 examined. In general, the atomic number of the radioactive element formed is either that of the parent element, or is less than this by 1 or 2 units, the first case being commonest among the heavier elements. It is assumed that the first stage is the capture of the neutron, and that this is followed by the ejection of a quantum of γ-radiation, a proton or an α-particle. The first stage presents no theoretical difficulty, but the subsequent ejection is not easy to understand. The theoretical difficulties are briefly discussed. AUTHOR.

3214. Artificially Produced Radioactive Elements. F. and (Mme.) Joliot. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 78–86, *Physical Society.*—Surveys the nature of nuclear reactions and describes the results of experiments on the bombardment of Al, B and Mg by Po α-particles. Reasons are given for preferring the hypothesis that the active nuclei formed are unstable isotopes, and the chemical tests in support of this are described. The paper deals with the mass of the neutron and discusses further cases of artificial radioactivity produced by α-particles and neutrons. W. E. P.

3215. Artificial Radioactivity. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 86–89, *Physical Society.*—*Discussion* by **J. D. Cockcroft; S. Maracineanu; J. C. McLennan, L. G. Grimmett and J. Read; L. Szilard.**

3216. Photoelectric Disintegration of the Diplon. H. A. Bethe and R. Peierls. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 93–94, *Physical Society.*—The problem of the photoelectric disintegration of the diplon is discussed theoretically, as also the excitation of diplons by electrons and by photons, and the scattering of neutrons by protons. The latter process should give an experimental method of distinguishing whether the forces between a neutron and a proton are exchange forces or ordinary ones, but it is concluded that the necessary experimental conditions could not at present be attained. AUTHORS.

3217. Nuclear Transformations with α-Particles and Neutrons. J. Chadwick and N. Feather. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 95–111, *Physical Society.*—The paper deals with the potential barrier concept and classifies the different processes which might occur when an α-particle penetrates a nucleus. The case where an α-particle is captured and a proton or neutron ejected is considered in detail, evidence as to the existence and location of energy levels being discussed. The heights of the potential barriers and resonance levels in a number of isotopes of light elements are given. With regard to neutron bombardment there is no potential barrier preventing free entry of the particle and consequently heavy as well as light elements can be successfully attacked by neutrons. The disintegration of N by neutrons is considered in detail. In this case and in that of other light elements, the capture of the neutron and the emission of an α-particle is the most favourable reaction. The paper concludes with a discussion of the types of reaction that seem to occur in heavier elements. W. E. P.

3218. Transmutations with Protons and Diplons. J. D. Cockcroft. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 112–129, *Physical Society.*—Gives a brief survey of the methods used for producing high-speed ions. The disintegration of B and C by protons and diplons respectively is considered in detail. The disintegration of O by diplons, F by protons, and of heavier elements by protons and diplons is also dealt with. The rate at which the number of disintegrations varies with the voltage applied to the bombarding particles is discussed theoretically and experimental results are given. There is also a discussion of the heights of the potential barriers round light particles and the chance of disintegration after penetration of the barrier by a neutron or diplon. W. E. P.

3219. γ-Rays from Nuclear Transmutations. H. R. Crane and C. C. Lauritsen. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 130–143, *Physical Society.*—γ-rays have been found resulting from the following processes: Li and F bombarded with protons; Be, B and C bombarded with deutons. Attempts have been made to determine the quantum energies by means of absorption measurements in Pb and in Cu, and also by means of cloud-chamber photographs of the recoil electrons and electron pairs ejected from a lead plate by the radiation. Counts of the relative numbers of electron pairs and of single negative recoil electrons produced by 12 m.e.V. and by 5·4 m.e.V. radiation have been made, and found to agree satisfactorily with the theoretical predictions of Oppenheimer and of Bethe and Heitler. Finally, a list of the excitation levels which have been found by the study of γ-ray emission from the various light nuclei is given, and this includes evidence for one, and possibly two, excitation levels in the α-particle. AUTHORS.

3220. Transformations by Hydrogen Ions. M. L. E. Oliphant. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 144–161, *Physical Society.*—Describes briefly the experimental arrangements used in the study of atomic transformations by accelerated positive ions and deals in detail with the reactions which occur when Li^7, Li^6 and Be^9 are bombarded by protons and deutons and when heavy hydrogen is bombarded by deutons. W. E. P.

3221. Disintegration and Synthesis of Nuclei and Elementary Particles. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 162–168, *Physical Society. Discussion by* **(Lord) Rutherford, H. A. Bethe, J. Chadwick, L. R. Hafstod, W. R. Hartree, M. Goldhaber, H. S. W. Massey.**

3222. Artificial Radioactivity. E. Segrè. *N. Cimento,* 12. *pp.* 232–239, *April,* 1935.—An ionisation chamber is constructed in the form of a steel cylinder 10 cm. in dia., 12 cm. long and filled with CO_2 at a pressure of 3 atmospheres. The central electrode was maintained at a potential of 200 V and connected to a Perucca electrometer, the capacity of the entire system being about 20 cm. A small Al window allowed the examination of β-rays emitted from the following elements after bombardment with slow neutrons, Al, Si, P, S, Cl, V, Cr, Mn, Fe, Cu, Zn, Ga, As, Br, Rh, Ag, In, I, Pr, Ir, Au, Th and U. For an account of the nature and the half-periods of the radioactive elements and the thickness of Al required to reduce the emitted β-rays to half intensity, the original paper should be consulted. F. C. C.

3223. Artificial Production of Elements of an Unknown Radioactive Family by the Irradiation of Thorium by Neutrons. Irène Curie, H. v. Halban, Jr. and P. Preiswerk. *Comptes Rendus,* 200. *pp.* 1841–1843, *May* 27, 1935.—Besides the three families in which natural radioactive bodies are grouped a fourth radioactive family of atomic weight of the form $4n + 1$, where n is a whole number, which has not yet been observed in nature, has been produced artificially by the irradiation of thorium by means of neutrons. For irradiation a vessel containing 300 to 700 m.c. of Rn mixed with powder of Be was usually employed. There exists in the irradiated Th at least four radioelements created artificially of periods about 1 min., 15 min., 25 min., and 3·5 hr., emitters of β-rays. The body of period 25 min. is probably the isotope of Th^{233} obtained by capture of the neutron in Th^{232}. The body of period 3·5 hr. appears to be an isotope of Ac. The body of period 15 min. has chemical properties resembling La and must be also an isotope of Ac. The radioelement of period 1 min. is very probably an isotope of Ra, ${}^{229}_{88}A$. [see following Abstract.] J. J. S.

3224. Radioactive Elements Produced on the Irradiation of Thorium by Neutrons. Irène Curie, H. v. Halban, Jr. and P. Preiswerk. *Comptes Rendus,* 200. *pp.* 2079–2080, *June* 17, 1935.—Referring to their previous paper [see preceding Abstract] the authors describe experiments which permit the identification of the new radioelement of period about 1 min. as an isotope of Ra, probably formed according to the reaction ${}^{232}_{90}Th + {}^{1}_{0}n = {}^{229}_{88}A + {}^{4}_{2}He$. From this isotope of Ra must be derived one or other of the radioelements of 15 min. and 3 hr. 30 min. which have been identified as isotopes of Ac. A new element of period from 2 to 3 min., an isotope of proto-actinium, has been found in Th irradiated by neutrons. These experiments are the first to exhibit in a distinct way the artificial production of two radioactive bodies originating the one from the other. J. J. S.

3225. Artificial Radioactivity of Ruthenium Bombarded by Neutrons. I. Kurtschatow, L. Nemenow and I. Selinow. *Comptes Rendus,* 200. *pp.* 2162–2163, *June* 24, 1935.—When neutrons from Rn + Be, after passing through about 10 cm. H_2O, fall on Ru there are produced radioactive nuclei of periods 40 and 100 sec., and 11 and 75 hr., of relative intensities proportional to 100, 100, 10 and 40. It is suggested that those of periods 40 and 100 sec. result from the reactions ${}^{104}_{44}Ru + {}^{1}_{0}n \rightarrow {}^{105}_{44}Ru + w_0$, followed by ${}^{105}_{44}Ru \rightarrow {}^{105}_{45}Rh + e$, and ${}^{105}_{45}Rh \rightarrow {}^{105}_{46}Pd + e$. No effect was obtained with neutrons not passed through H_2O. [See Abstract 1899 (1935).] C. A. S.

3226. Energy of Neutrons and the Fermi Effect. I. Kurtschatow, L. Mysovski, M. Eremejew and G. Shchepkin. *Phys. Zeits. d. Sowjetunion,* 7–3. *pp.* 257–261, 1935. *In English.*—The radioactivity of Al, Si, P, Fe, Br, Ag and I excited by neutrons from F and Be is studied. It is shown that whenever the nucleus is formed as the result of a neutron being captured without emission of a heavy particle, radioactivity results whether the irradiating neutrons are due to Be or F. Moreover it is shown that neutrons from fluorine lead to the formation of artificially radioactive phosphorus. AUTHORS.

3227. Wilson-Chamber Observations and the Fermi Effect. I. Kurtschatow and G. Latishev. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 262–266, 1935. *In English.*—The first problem considered here refers to the determination of the number of positrons and electrons appearing on the disintegration of radioactive bromine. The second problem is the passage of neutrons through compounds containing hydrogen.

AUTHORS.

3228. Transformation of Al by Neutron Bombardment. H. Klarmann. *Zeits. f. Physik,* 95. 3–4. *pp.* 221–226, *June* 4, 1935.—Examination of cloud tracks of particles emitted from Al under neutron bombardment shows the existence of protons of maximum range 9 cm. and a few α-particles of range up to 3·3 cm. From 9200 paired photographs, 143 tracks were obtained, 68 of which were suitable for more exact measurement. The number of protons decreases rapidly and continuously as their range increases. Thirty disintegrations of air with the emission of α- or heavier particles were also observed; comparison with Al shows a considerably greater effective cross-section for the latter.

F. C. C.

3229. Disintegration of Boron and Other Light Elements by Slow Neutrons. E. Amaldi. *N. Cimento,* 12. *pp.* 223–231, *April,* 1935.—Using a proportional amplifier, radioactive isotopes of the following elements are produced on bombardment with slow neutrons: F^{20} (40s); Na^{24} (15h); Mg^{27} (10m), formed from Mg^{26} present to 1 % in ordinary Mg; Al^{28} (2·3m); Si^{31} period some hours formed from Si^{30} present to 3 % in ordinary Si and K^{42} (16h) formed from K^{41}. The isotopes responsible for the effect in the following elements have not yet been identified: Se (35m), Rb (100m), Pa (15m; 12h), Cd, Sb (2·5d), Cs, Ba (80m), Gd (8h), W (1d) Re and Pt (45m). The abnormally high absorption of B for slow neutrons is shown with an ionisation chamber to be accompanied by the emission of an α-particle of range 5 to 10 mm. in air at N.T.P. It is considered that the disintegration takes place according to the equation ${}^{10}_{5}B + {}^{1}_{0}n = {}^{7}_{3}Li + {}^{4}_{2}He$ and not with the formation of two α-particles and one ${}^{3}_{1}H$ as suggested by Chadwick and Goldhaber.

F. C. C.

3230. Disintegration of Lithium by Slow Neutrons. D. Z. Budnizki, I. W. Kurtschatow and G. D. Latishev. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 474–483, 1935. *In English.*—Experiments with the Wilson chamber show that collisions between neutrons and lithium lead to a nuclear reaction according to the equation ${}_{3}Li^{6} + {}_{0}n^{1} = {}_{2}He^{4} + {}_{1}H^{3}$, ${}_{2}He^{4}$ and ${}_{1}H^{3}$ being ejected in opposite directions with ranges of 20 and 65 mm. respectively in air at atmospheric pressure. The collision cross-section for slow neutrons is shown to be 2×10^{-22} cm.^{2}. AUTHORS.

3231. Nuclear Processes in Lithium on Bombardment with α-Rays. K. Schnetzler. *Zeits. f. Physik,* 95. 5–6. *pp.* 302–311, *June* 17, 1935.—The processes occurring in the nucleus when Li is exposed to the action of α-rays from Po were investigated in connection with each other. γ and neutron excitation functions were obtained. The first sets in at $2 \cdot 3 \times 10^6$ eV (1·3 cm. range), the second at $4 \cdot 7 \times 10^6$ eV (3·3 cm. range). The late setting-in of the neutron emission is not made deceptive by disturbing influences and γ quanta and neutrons are derived from different single processes. Negative or positive electrons could be found neither after nor during the irradiation. The neutron emission is related to Li^7, the appertaining amount of energy being 3×10^6 eV. The γ-radiation of about $0\cdot5 \times 10^6$ eV is explained by excitation of the Li nucleus without capture of the α-particle. J. J. S.

3232. Yield of α-Particles from Lithium Films Bombarded by Protons. R. G. Herb, D. B. Parkinson and D. W. Kerst. *Phys. Rev.*, 48. *pp.* 118–124, *July* 15, 1935.—The absolute yield of α-particles from a thick target of Li bombarded by protons has been determined using proton energies up to a maximum of 400 kV. The values obtained for the yield of α-particles per 10^6 protons, at several different voltages are 16·3 at 250 kV, 33·4 at 300 kV, 58·0 at 350 kV and 92·8 at 400 kV. The yields of several thin films have been studied in considerable detail. Results show that the thin film yield increases linearly with voltage from 180 kV up to 400 kV, and at the upper voltage shows no tendency to approach a constant value. The thin film yield curves were smooth, giving no evidence for the existence of resonance levels. AUTHORS.

3233. γ-Radiation from Lithium Bombarded with Protons. H. R. Crane, L. A. Delsasso, W. A. Fowler and C. C. Lauritsen. *Phys. Rev.* 48. *pp.* 125–133, *July* 15, 1935.—The γ-radiation emitted when Li is bombarded with protons has been studied by means of a cloud chamber operating in a magnetic field of 2000 gauss. The spectrum consists of at least eleven lines, the highest of which is 16 MEV. The voltage excitation curve for the γ-radiation shows a maximum at 650 kV proton energy, and is very different from the excitation curve for the 8·4 cm. α-particles emitted under the same conditions. An attempt is made to interpret these results. The experimental procedure and methods of measuring the cloud chamber tracks are also discussed. AUTHORS.

3234. Isotopes of Radioactive Elements and their Disintegration. H. J. Walke. *Phil. Mag.* 20. *pp.* 25–32, *July*, 1935.—The hypotheses that the missing isotopes near the upper limit of the mass-range of any element may be regarded as β-radioactive links whereby each element evolved from the one preceding it in the periodic table, and that the characteristic instability of the radioactive elements is α-ray instability are shown to be consistent with what is known of natural and artificial radioactivity. [See Abstract 1307 (1935.] C. A. S.

3235. Systematics of Isotopes. G. Beck. *Phys. Rev.* 48. *pp.* 47–48, *July* 1, 1935.—A comparison between the older views on the structure of nuclei and recent ideas is given and possibilities are discussed which might guide to a decision between the two views. AUTHOR.

3236. Slow Neutrons. E. Fermi and F. Rasetti. *N. Cimento*, 12. *pp.* 201–210, *April*, 1935.—After showing by negative experiments with 100 mg. of Ra alone that the increased activation (produced in many elements when layers of paraffin wax are interposed between element and neutron source) cannot be attributed to the action of γ-rays, further experiments are made with slow neutrons. Elements showing strong increase in activation as the velocity of the incident neutrons is reduced are Na (15h), Al (2·3m.), V (3·7m.). Ag (22s; 2·3m.), Cu (5m.), Rh (44s; 3·9m.) and I (25m.), while Si (2·3m.), Al (10m.), Mg (40s.), Mn (3·7m.), and Zn (5m.) are very little affected. In all cases the increased activation occurs when the active element is an isotope of the bombarded element, the initial energy of the neutron being emitted in the form of

γ-rays when capture occurs. Denoting by α the ratio of the effect with paraffin wax present to the effect with it absent, α varies from 1·6 with U (15s.; 13m.; 100m.) to 40 with V (3·7m.). Complementary experiments on the absorption coefficient of elements for slow neutrons, using Rh as indicator gives values varying from 0·004 gm./cm.^{2} for B to 0·014 gm./cm.^{2} for Cd. The absorption curve is not exponential, the coefficient of absorption decreasing with increasing thickness of absorber. The properties of slow neutrons are discussed in terms of de Broglie's wave theory.

F. C. C.

3237. Slow Neutrons. B. Pontecorvo. *N. Cimento,* 12. *pp.* 211–222, *April,* 1935.—Using a Rh detector an examination is made of the variation in the intensity of the neutrons at different distances from a Ra-Be source immersed in water. When the activation was sufficient measurements were made with an ionisation chamber: otherwise a counter was used. The curve is difficult to interpret being governed by the unknown distribution of velocity in the primary neutron beam. Substitution of a 2 % solution of H_3BO_3 for water yields a curve of the same type in spite of the very large cross-section of the B nucleus for neutrons. Experiments are also made to detect diffusion plus absorption with different geometrical arrangements of source, detector, and absorbing screen; none of the absorption curves is exponential. Immersion of the source and detector in paraffin at 200° C. and in a mixture of equal density consisting of pentane and benzole at 20° C. showed no difference in the intensity of activation. The energy of the slow neutrons is therefore not of the order of thermal energies and remains unknown. A relatively small increase in activation also occurs when screens of elements other than paraffin wax are interposed between source and detector but the interpretation of the effect must be quite different. F. C. C.

3238. Scattering of Slow Neutrons by Hydrogen. M. Eremejew I. Kurtschatow and G. Shchepkin. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 267–273, 1935. *In English.*—A method is described for determining the mean free path of slow neutrons in compounds containing hydrogen. A series of experiments is carried out by this method and the effective collision radius of slow neutrons with protons is found to be 2×10^{-12} cm.

AUTHORS.

3239. Levels of the Neutron. E. Sevin. *Comptes Rendus,* 200. *pp.* 2070–2072, *June* 17, 1935.—The case is considered of an electron in a field of force acting at a known angle with the direction of velocity v of the particle. It is shown that in the limit when $v = c$, the electron would conserve constant velocity in its orbit. This condition is realised in the liaison of an electron and proton forming a neutron. It is concluded that when the neutron absorbs energy setting out from its fundamental orbit it describes a spiral with the velocity of light c, and there is conservation of kinetic energy; the potential energy, which is negative, diminishes in absolute value, and its variation is a measure of the increase of energy of the system. The calculated initial potential energy is $- 9{\cdot}717\ m_0c^2$, and it follows that the mass of the neutron lies within the limits 1·00706 and 1·01235. The kinetic moment corresponding to the fundamental level is expressed in quantised form, whence the numerical values of the masses and their separations are found in agreement with experimental values. [See Abstract 2856 (1935).] N. M. B.

3240. Is there a Neutron of Mass 2? S. Flügge. *Zeits. f. Physik,* 95. 5–6. *pp.* 312–318, *June* 17, 1935.—The possible existence of a neutron of mass 2 has hitherto scarcely been thoroughly discussed. In the present paper a large number of indications are brought together which seem to show that a conglomerate of two neutrons with antiparallel directed spins plays an actual part in the structure of the nucleus. [See following Abstract.] J. J. S.

3241. Possible Occurrence of Bineutrons in Nuclear Transformations. S. Flügge and A. Krebs. *Zeits. f. Physik*, 95. 5–6. *pp.* 319–320, *June* 17, 1935.—The results obtained by Lawrence and his co-workers in the bombardment of various elements with deutons are considered in connection with the evidence for the possible existence of bineutrons. [See preceding Abstract.] J. J. S.

3242. Electronic Structures of Polyatomic Molecules and Valence. Part VI. Method of Molecular Orbitals. R. S. Mulliken. *J. Chem. Phys.* 3. *pp.* 375–378, *July*, 1935.—The use of the method of non-localised molecular orbitals in building up a conceptual scheme or qualitative theoretical framework into which empirical data (chemical and spectroscopic) can be fitted, is emphasised. This should be distinguished from the use of the method, often with rough " LCAO " approximations (linear combinations of atomic orbitals), in semiquantitative calculations. (For Part V see Abstract 3289 (1933).] AUTHOR.

3243. Aromatic and Unsaturated Molecules. E. Hückel. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter, pp.* 9–35, *Physical Society.*—The behaviour of induced polarities of substituted benzene compounds is explained by quantum theory. The theoretical treatment has been extended so far that only one constant, the resonance integral, is required. Calculated energy contents of a number of compounds agree well with the observed values. A. S. C. L.

3244. Binding Forces on Quantum Theory. F. Hund. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter, pp.* 36–45, *Physical Society.*—The distinction between heteropolar and homopolar bonds is outlined. The following problems are then discussed : Why is H_2 diatomic ? Why is H_2O bent and why is this angle characteristic of many O compounds ? Why is Na a metal and Cl_2 a gas although both are monovalent ? Why do solid insulators such as diamond (*i.e.*, non-ionic lattices with strong binding) exist ? The nature of transition cases, such as As, is then discussed. A. S. C. L.

3245. Molecular Structure of Benzene. G. B. Bonino. *Gaz. Chimica Italiana,* 65. 5. *pp.* 371–423, 1935.—After reviewing the history of the work on the constitution of the aromatic nuclei, a summary is given of the application of quantum and wave mechanics towards an elucidation of the problem. The methods of Pauling and Hückel on the aromatic property of benzene are discussed, and then some concepts, introduced at the conference of the International Congress of Madrid, 1934, are brought forward to show that, from physical reasoning, structures similar to benzene rings can be obtained. There is a close agreement between the physical conceptions and the chemical phenomena of such compounds and their derivatives. H. M. B.

3246. Effect of Change of Temperature on the Constitution of Water in Solutions of Electrolytes. C. S. S. Rao. *Roy. Soc., Proc.* 151*A. pp.* 167–178, *Aug.* 1, 1935.—The effect of a rise in temperature on the constitution of water in the pure liquid and in 8*N* solutions of LiCl, $NaNO_3$, and H_2SO_4 has been investigated by a study of the structure of the Raman water-band in them. The results have been explained as being caused by a simplification of the more complex water-molecules into the simpler types, as well as by a breaking down of the more complex hydrates into less complex ones and simple water-molecules with rise of temperature. The peculiar result of increased broadening of the band noticed at 95° C. in sulphuric acid has been interpreted as due to a breaking down at this high temperature of the hydrates present in solution into free ions and single water-molecules and some of them, perhaps, into single water-molecules and hydrates with one associated molecule of water of hydration. [See also Abstract 949 (1935).] AUTHOR.

3247. Magnitudes of Molecules and of Colloidal Micelles. A. Boutaric. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 101–106, *June* 28, 1935.—Lecomte du Noüy has recently described an interesting capillary method for the evaluation of the absorption surface of certain substances and this process has been modified by the present author in the direction of greater accuracy for comparing the sizes of dissolved molecules. A mathematical discussion of the process is included. H. H. Ho.

See also Abstracts **3255**, **3287**, **3400**, **3404**, **3407**, **3412**, **3413**, **3416**, **3452**, **3461**, **3496**, **3520**, **3522**, **3547**, **3561**, **3578**, **3579**, **3580**, **3622**, **3659**.

COLLOIDS.

3248. Cataphoresis of Small Particles in Water. C. L. S. Gilford. *Phil. Mag.* 19. *pp.* 853–878, *May*, 1935.—An experimental study of the velocity of cataphoresis (v) of particles of clove oil, beeswax, graphite, sugar C, Sb, Sb_2O_3, Sb_2S_3 and MnO_2 gave the following results: (i) v varies with temperature only in so far as the viscosity of the medium (conductivity water) varies; (ii) v varies with particle-size as found by previous workers (and contrary to the simple Helmholtz theory); (iii) all substances show a definite cataphoresis even though v is occasionally negative; this is true even of metals prepared under conditions precluding the presence of oxide films; (iv) v varies with the shape and orientation of the particles; in particular v (longitudinal)/v (transverse) for particles of needle shape is 1·8 as compared with the ratio 2 predicted by hydrodynamical theory. Result (iii) is considered in relation to Henry's conclusion, that for spherical particles of high conductivity v should be zero since all lines of force would cut their surfaces orthogonally; it is shown that according to the Debye-Hückel theory the electric double layer, considered as bounding a space-charge region, will be distorted in an electric field, and there will be a resultant force upon such particles; the matter is analysed quantitatively. L. V. C.

3249. Cataphoresis of Particles of the Fatty Acids and Related Compounds. T. Alty and O. Johnson. *Phil. Mag.* 20. *pp.* 129–145, *July*, 1935.—The cataphoretic behaviour of single particles of a number of fatty acids and related compounds has been examined in pure water and in dilute HCl solutions, and it has been shown that the mobility of the particle depends partly on the nature of the water-soluble group in the molecule and partly on the length of its hydrocarbon chain. For molecules having a constant chain-length the mobility decreases as the nature of the end group is altered in the order $-CONH_2$, $-COOH$, $-CH_2OH$, the last two being almost equal. The mobility of molecules having the same end group ($-COOH$) decreases as the length of the hydrocarbon chain is increased, while the presence of a double bond near the middle of the chain, as in erucic acid, increases the mobility of the particle. The mobilities of all the substances examined decreased with increasing H-ion concentration of the surrounding liquid. Authors.

3250. Surface Conductivity and its Significance. J. J. Bikerman. *Kolloid Zeits.* 12. *pp.* 100–108, *July*, 1935.—A summary of the knowledge of this subject, under the headings : I. Surface conductivity ; (*a*) theory, (*b*) methods of measurement, (*c*) results. II. Significance of surface conductivity for the electrical properties of colloidal and capillary structures ; (*a*) sedimentation potential, (*b*) flow potential, (*c*) electro-osmosis, (*d*) cataphoresis, (*e*) conductivity, (*f*) dielectric constants, (*g*) polarisation of the membrane. T. H. P.

3251. Isoelectric Point of Isinglass. H. Freundlich and P. S. Gordon. *Faraday Soc., Trans.* 31. *pp.* 915–919, *July*, 1935.—The isoelectric point of isinglass in aqueous solution was found to be 5·9, when measuring by a microscopic method the cataphoretic velocity of quartz particles, coated with isinglass, in buffer solutions. The sedimentation volume of quartz particles in buffer solutions containing isinglass showed a maximum at 5·8 to 6·0, thus confirming the correlation between maximum of sedimentation volume and isoelectric point found in solutions of other proteins. Authors.

3252. Reciprocity Theorem in Colloid Optics. R. S. Krishnan. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 782–788, *May*, 1935.—A simple method of deriving the following algebraic relation between ρ_u, ρ_v and ρ_h is given, $\rho_u = (1 + 1/\rho_h)/(1 + 1/\rho_v)$ applying the general dynamical principle of reciprocity formulated by Helmholtz and Rayleigh, where ρ_u, ρ_v and ρ_h are the measures of the depolarisation of the Tyndall scattering when the incident light is respectively (1) unpolarised, (2) polarised with its electric vector vertical, and (3) polarised with its electric vector horizontal. The conclusions derived from the reciprocity principle admit of a very simple and direct experimental test which has been carried out and found to be satisfied by all kinds of colloidal solutions, emulsions, suspensions, protein solutions, etc., irrespective of size, shape or structure of the particles contained in them or of their non-uniformity. [See Abstract 2990 (1935).] Author.

3253. Validity of the Rayleigh Formula in Colloidal Systems. L. W. Smirnow. *Kolloid Zeits.* 71. *pp.* 261–265, *June*, 1935.—The dependence of the power, x, of the wave-length of the scattered light (in the expression for its intensity) on the degree of dispersity of the colloidal system is investigated. For white non-metallic systems it is found that x decreases from 3·8 to 1·3 while the particle radius increases from 60 $m\mu$ to 200 $m\mu$. C. B. A.

3254. Influence of Anisometric Particles in Thixotropic Sols and Suspensions. H. Freundlich and F. Juliusburger. *Faraday Soc., Trans.* 31. *pp.* 920–921, *July*, 1935.—Thixotropic sols (e.g., those of V_2O_5) or suspensions (e g., gypsum + water) containing anisometric particles solidify rapidly, in the course of a few seconds, as soon as the particles are oriented by a gentle movement. The same systems need a much longer time, up to an hour, to solidify spontaneously. Authors.

3255. X-Ray Studies of the Structure of Hair, Wool, and Related Fibres. Part III. Configuration of the Keratin Molecule and its Orientation in the Biological Cell. W. T. Astbury and W. A. Sisson. *Roy. Soc., Proc.* 150*A*. *pp.* 533–551, *July* 1, 1935.—When keratin fibres, *e.g.*, of whalebone, strips of horn, finger nail (transverse to length of finger), are squeezed laterally to a thickness of about 1/5th the original in presence of steam or hot water the keratin is transformed into β-keratin, the crystallites whereof rotate about their long axes so that the protein side chains are normal to the plane of flattening, showing that the " backbone " and " side-chain " spacings of the keratin " grid " are mutually perpendicular. The length, thickness, and width of the crystallites of β-keratin are given respectively by the length and width of the grid, and the number of grids in contact. The biological cells in such substances are generally flat, the flat side being parallel to the natural surface, but the protein side chains are not perpendicular to the cell wall, the keratin grids within the cell having a random orientation about the fibre axis. As regards the evolution of fibrous protein it is shown that the principal periodicities in feather keratin are closely related to the corresponding periodicities of crystalline pepsin. [For Part II see Abstract 1398 (1934).] C. A. S.

3256. Determination of the Granulation Curve from Centrifugal Experiments. A. Romwalter and M. Vendl. *Kolloid Zeits.* 72. *pp.* 1–3, *July*, 1935.—It is shown that Oden's method is applicable also to centrifugal experiments with shock-free running centrifuges, whereby the pipette method would give the simplest solution. Schlesinger's work [see Abstract 2699 (1934)] on the use of simple Becher centrifuges for the determination of particle size in colloidal solutions should also be consulted. H. H. Ho.

See also Abstracts 3247, 3549, 3618.

CRYSTAL STRUCTURE AND PROPERTIES.

3257. Dynamical Theory of the Diamond Lattice. N. S. N. Nath. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 841–849, *May*, 1935.—Work previously reported [see Abstract 550 (1935)] is extended by the deduction, based on the known crystal structure of diamond and the binding forces between the atoms, of expressions for the three elastic constants of diamond in terms of the molecular force constants. The numerical values of the constants are evaluated approximately. N. M. B.

3258. Dynamics of Molecular Crystal Lattices. Part III. Models of Vibrating Crystals. V. Deitz and D. H. Andrews. *Frank. Inst., J.* 219. *pp.* 703–715, *June*, 1935.—Models of Ne and N_2 crystals were made of wooden blocks, each about an inch cube, connected by elastic bands giving suitable relative tensions as indicated by X-ray analysis of the crystals, the whole being enclosed in a frame with an arrangement for causing vibration. An isotope effect in Ne was obtained by replacing one of the interior blocks by a heavier one. Numerous photographs are given of the " crystal " at rest and in vibration. [For Part II see Abstract 2810 (1935).] C. A. S.

3259. Statistical Theory of Superlattices. H. A. Bethe. *Roy. Soc., Proc.* 150*A*. *pp.* 552–575, *July* 1, 1935.—The order of an alloy AB containing equal numbers of atoms of A and B is calculated statistically by determining the " order of neighbours," σ, and the " long distance order," S, These are defined, σ, as the difference between the probabilities of finding a B and an A atom next beside a given A atom, and, S, between those of finding an A atom and a B atom in a position which should be occupied by an A atom if order is perfect, interaction between nearest atoms only being assumed. S and the energy are calculated as functions

of temperature. It is shown that S vanishes at a certain critical temperature, at which there should be rapid change in many physical properties, *e.g.*, specific heat and electrical conductivity. [See Abstract 3107 (1934).]
C. A. S.

3260. Recrystallisation of Silver. E. Osswald. *Zeits. f. Metallkunde*, 27. *pp.* 101–104, *May*, 1935.—The recrystallisation temperature as determined by X-rays agrees with that determined by metallographic methods. Extremely small amounts of impurity have a marked effect on the recrystallisation temperature of very pure Ag. Very pure Ag shows some spontaneous recrystallisation at room-temperature and this too is strongly influenced by a trace of impurity. J. T.

3261. Production of a Thin Layer of Single Crystals of Ag and their Interaction with Kathode Rays. L. Royer. *Ann. d. Physik*, 23. 1. *pp.* 16–20, *May*, 1935.—The author criticises the results of Lassen and Brück [see Abstract 1351 (1935)], who find that the orientation of the 3 cube faces (001) (100) and (010) of a Ag crystal formed on a rock-salt base are parallel to the 3 similar cube faces of rock-salt. He suggests that the (001) face of the Ag crystal is parallel to the (001) face of the rock-salt but that the (100) and (010) faces of the Ag are parallel to the (110) and $(1\bar{1}0)$ faces of the rock-salt and he adduces evidence from measurements of the lattice parameters and from similar crystal depositions in support of his suggestions. In reply, **H. Lassen** and **L. Brück** point out that Royer refers to crystallisation from solution in which the orientation is such that planes which are parallel have approximately the same atomic spacings. Different conditions obtain in the case of the deposition of vapours *in vacuo* which was employed by the authors in the preparation of their Ag layers. An examination of over 100 specimens by the electron diffraction method has shown that the authors' statements are correct and that they are not confined solely to the case of Ag crystals.
H. J. H. S.

3262. Structures of Compounds of Be with Cu, Ni and Fe. L. Misch. *Zeits. f. phys. Chem.* 29. *Abt.B.* 1. *pp.* 42–58, 1935.—CuBe and NiBe are found to have the CsCl structure with $a = 2{\cdot}698 \pm 0{\cdot}007$ Å, and $a = 2{\cdot}603 \pm 0{\cdot}003$ Å, respectively. $CuBe_2$ and $FeBe_5$ are of the $MgCu_2$ type with 24 atoms in the unit cell. For $CuBe_2$, $a = 5{\cdot}940 \pm 0{\cdot}003$Å and for $FeBe_5$, $a = 5{\cdot}878 \pm 0{\cdot}006$ Å. Ni_5Be_{21} has a deformed γ-brass structure with $a = 7{\cdot}56$ Å. $FeBe_2$ is hexagonal, of the $MgZn_2$ type, with 12 atoms in the unit cell. The lattice dimensions are: $a = 4{\cdot}212 \pm 0{\cdot}005$ Å and $c = 6{\cdot}834 \pm 0{\cdot}005$ Å, giving $c/a = 1{\cdot}623$. J. T.

3263. Structure of CuHg. F. Schoszberger. *Zeits. f. phys. Chem.* 29. *Abt.B.* 1. *pp.* 65–78, 1935.—Although the valency electron ratio for CuHg is 1 : 1, diffraction photographs show that its structure is the same as that of γ-brass. Hence Hume-Rothery's rule is not applicable. Powder photographs, rotating crystal and oscillation photographs are used in the determination of the structure. The lattice constant is $9{\cdot}406 \pm 0{\cdot}004$ Å. J. T.

3264. Structure of Liquid and Solid Mercury by Kathode-Ray Diffraction. H. Kakesita. *Kyoto Coll. Sci., Mem.* 17. *pp.* 241–248, *July*, 1934.—Diffraction patterns of Debye-Scherrer rings were taken by the method of kathode-ray reflection on the surface of liquid and solid mercury. The author observed that both patterns belonged equally to the face centric rhombohedral unit of the crystalline system, and that the diameters of the rings of solid mercury were larger than those of liquid mercury by 10 %. It is therefore concluded that liquid and solid mercury have the same structures, but the intermolecular distance of the solid state is contracted compared with that of the liquid state by this percentage. AUTHOR.

3265. Structure and Physical Properties of Thin Films of Metals on Solid Surfaces. E. N. da C. Andrade and J. G. Martindale. *Roy. Soc., Phil. Trans.* 234*A*. *pp.* 69–101, 1935.—The uncertain and often contradictory results obtained by numerous workers on the colour and physical properties of sputtered films of Au and Ag are shown to be due to uncontrolled heating. Uniform and reproducible films may be prepared by slow sputtering on a cooled surface. Such films are amorphous when examined microscopically and are probably much less than 10^{-5} cm. across. They are easily contaminated by Hg vapour, which produces effects similar to those obtained on heating the film. Films about 50 atoms thick, when maintained at a temperature of about 230° C. for Ag and about 400° C. for Au, show initial crystallisation, consisting in the formation of small birefringent aggregates showing spherulitic figures in polarised light. This phenomenon is independent of the nature of the non-metallic surface on which the film is deposited. The formation of the aggregates and their growth as the temperature increases are described. Cubic crystals form on prolonged heating which have their (111) faces parallel to the supporting surface; growth normal to the (111) surface proceeds with difficulty. The difference in behaviour of thin and thick films is described. The results of electrical measurements on thin films are correlated with the results obtained by the authors. Films on glass, quartz and mica are examined and the results are discussed with reference to the work by Robertson, Fox and Martin on diamonds. H. J. H. S.

should be: 235.

3266. X-Ray Proof of Lattice Distortion in Cold-Wrought Nickel. W. E. Schmid and E. A. W. Müller. *Zeits. f. techn. Physik*, 16. 6. *pp.* 161–164, 1935.—The magnitude of the internal stresses set up in polycrystalline Ni by plastic deformation has been estimated by Kersten from magnetic data [see Abstract 3822 (1933).] For comparison, the breadths of the lines in the Debye-Scherrer diagram were investigated, and conclusions were drawn as to the crystalline stresses. With Ni, as with Cu [see Abstract 2713 (1932)] and Fe, the breadth of the line increases in a linear manner with the externally applied stress. The internal stress calculated from the line-breadth does not agree with the value found by the magnetic method. G. E. A.

3267. Mosaic Texture of Rock-Salt. P. P. Ewald and M. Renninger. *International Conference on Physics, London*, 1934, *Vol. II. Solid State of Matter, pp.* 57–61, *Physical Society*.—An account of experimental work on rock-salt is given from which it is concluded that mosaic texture is a property of individual crystals. Artificial perfect crystals were prepared and found by X-ray examination to differ from cleaved natural ones. A. S. C. L.

3268. Evidence of Group Phenomena in the Solid Metallic State. A. Goetz. *International Conference on Physics, London*, 1934, *Vol. II. Solid State of Matter, pp.* 62–71, *Physical Society*.—The arguments for a secondary structure in crystals are outlined. Evidence is given for the persistence of groups above the melting point. The segregation of impurities during crystallisation also supports the group theory. The coefficient of expansion in bulk is compared with the value deduced from X-ray determination of temperature changes of the lattice and the differences discussed from the view point of " groups." A. S. C. L.

3269. Deviations from the Ideal Lattice. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter, pp.*109– 135. —*Discussion* by **C. H. Desch, E. N. da C. Andrade, W. H. Bragg, G. Antonoff, J. D. Bernal, J. Brentano, W. G. Burgers, F. Canac, J. A. Darbyshire, G. I. Finch, R. H. Fowler, R. Hadfield, A. Joffé, E. Orowan, B. Lockspeiser, A. Smekal, R. Robertson, C. F. Tipper, A. E. H. Tutton.**

3270. Structure of Meta-Azotoluene. M. Prasad and P. H. Dalal. *Indian Journ. Phys.* 9. *pp.* 319–322, *May,* 1935.—The crystals of m-azotoluene develop a (100), b (010) and o (111) faces, and belong to rhombic bipyramidal class and the axial ratio is a : b : c = 0·8556 : 1 : 0·5438. AUTHORS.

3271. Structure of Para-Toluidine. J. Wyart. *Comptes Rendus,* 200. *pp.* 1862–1864, *May* 27, 1935. *In French.*—The crystals are orthorhombic with the following cell dimensions: $a = 5{\cdot}98$ Å, $b = 9{\cdot}05$ Å, $c = 23{\cdot}3$ Å. The unit cell contains 8 molecules CH_3–C_6H_4–NH_2. The six nuclear atoms are at the corners of a regular hexagon, NH_2 is 1·18 Å away from the neighbouring C atom, and is outside the plane of the nuclear group. F. I. G. R.

3272. Structure of Cyanuric Triazide. I. E. Knaggs. *Roy. Soc., Proc.* 150*A. pp.* 576–602, *July* 1, 1935.—The hexagonal unit cell has a 8·73, c 5·96 Å, and contains 2 molecules. The molecules are planar with a trigonal axis perpendicular to the plane. They are arranged in sheets 2·98 Å apart, and staggered with regard to one another. The C_3N_3 ring is hexagonal with alternate single and double bonds, the distances C–N being alternately 1·38 and 1·31 Å, and the angles NCN and CNC respectively 127° and 113°. The azide groups are linear, $-N=N\equiv N$, with $N=N$ 1·26 and $N\equiv N$ 1·11 Å, each is obliquely linked only to a C atom, $C-N = 1{\cdot}38$ Å, and the angle CNN = 114°, while the angles N (azide) CN (ring) are 120° and 113°. The magnetic susceptibility, $\chi_m \times 10^6$, is $-$ 102 parallel and + 80 perpendicular to the principal axis [see Abstracts 2712 (1933) and 557 (1935)]. C. A. S.

3273. Atomic Distances in Organic Compounds by X-Ray Analysis. J. M. Robertson. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter, pp.* 46–49, *Physical Society.* —Summary of experimental determinations of interatomic distances in a large number of C compounds. A. S. C. L.

3274. Structure of Molecules and of the Ideal Lattice. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter, pp.* 50–53.—*Discussion* by **J. D. Bernal, P. P. Ewald, A. Müller, J. C. Slater.**

3275. Grain Formation and Recrystallisation. Part I. M. Kornfeld. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 432–441, 1935. *In German.*—Definitions are suggested for the concepts of grain-formation, threshold of recrystallisation, recrystallisation-capacity. The relation between velocity of grain-formation and of growth of new grains (in a linear sense), and the degree of deformation is obtained. F. I. G. R.

3276. Colour Centres in Alkali Halide Crystals. R. W. Pohl. *Kolloid Zeits.* 71. *pp.* 257–261, *June,* 1935.—The paper contains a short account of the origin and optical properties of colour centres and of their rôle in the investigation of the elementary photochemical process in salt crystals. Numerous literature references are given. C. B. A.

3277. Quantum Yield in Formation of Colour Centres in KBr Crystals. R. Hilsch and R. W. Pohl. *Göttingen Nachrichten, Fachgruppe* 2. 1. 19. *pp.* 209–214, 1935.—Using the Hg lines 2540 and 2650 for experiments at about 500° and 600° respectively the photoelectric current obtained when such light falls on a sensitised crystal of KBr [see Abstract 2059 (1935)] was measured. The yield, η, became approximately 100% for temperatures above 400°, being given by $\eta = 1 - (1 - e^{-\epsilon/kT})^A$ where e is the elementary charge, $\epsilon = 0 \cdot 085e$, and $A = 7$. The transformation of the U-centres into visible (F-) centres is thus parallel with the optical dissociation of the molecules and depends on the optical absorption action and the heat energy of the A (7) neighbouring atoms. The total probability of an electron of one of these atoms having sufficient energy to allow of an exchange of place is $1 - (1 - e^{-\epsilon/kT})^A$, such electrons only moving through a distance of molecular dimensions. C. A. S.

3278. Cause of Low Mechanical Strength. A. Joffé. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 72–76, *Physical Society.*—The large discrepancy between observed and calculated tensile strengths of crystalline substances is also exhibited by amorphous bodies such as glass. Two kinds of rupture are to be distinguished : (1) plastic, in which there is reduction of area at some place before rupture ; and (2) brittle rupture. Brittleness occurs when the elastic limit reaches the practical tensile strength. Experiments are described to illustrate the importance of surface conditions on tensile strength and the conclusion reached is that practical weakness is essentially due to sharp surface discontinuities. A. S. C. L.

3279. Mechanism of Brittle Rupture. A. Joffé. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 77–80, *Physical Society.*—Experiments to show that tensile weakness of glass and quartz is due to surface discontinuities. These irregularities exist throughout the specimen but are effective in lowering the tensile strength only at the surface. A. S. C. L.

3280. Rupture of Plastic Crystals. E. Orowan. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 81–92, *Physical Society.*—Rupture starts from nuclei. These are cracks which may develop by plastic slip and an explanation of practical tensile strength becomes possible but it is suggested that a secondary block structure is not capable of explaining the observed facts. A. S. C. L.

3281. Structure-Sensitive Properties of Salt Crystals. A. Smekal. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 93–109, *Physical Society.*—Gaps and local variations of orientation are formed during crystallisation and therefore occur along the principal planes of growth. Secondary flaws are those resulting from alteration of the primary ones by thermal or mechanical treatment or new ones due to the same causes. The two types can be distinguished experimentally in rock-salt. A. S. C. L.

3282. Shear Hardening and Recrystallisation of Al Single Crystals. W. G. Burgers. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 139–160, *Physical Society.*—Review of investigations of the deformation and recrystallisation of Al. Discussion of plastic deformation and of dependence of recrystallisation on the number of glide planes involved in the shearing. A. S. C. L.

3283. Plasticity, Crystallographic and Non-Crystallographic. E. Schmid. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 161–170, *Physical Society.*—Discussion of plasticity of crystals with reference to slip and to mechanical twinning. Critical yield stresses are given for a number of crystal planes and also the temperature variations. The effect on twinning of temperature is less marked but it also leads to strengthening of the crystals. A. S. C. L.

3284. Plasticity and Strain Hardening in Crystals. *International Conference on Physics, London,* 1934, *Vol. II. Solid State of Matter. pp.* 171–183.—*Discussion* by **H. J. Gough, E. N. da C. Andrade, W. F. Berg, R. Hadfield, A. Smekal, E. Schmid.**

3285. New Crystallography. W. L. Bragg. *Roy. Soc., Edinburgh, Proc.* 55. 6. pp. 62–71, 1935.—A lecture review dealing with recent fields of enquiry by X-ray methods applied to the following special branches—Inorganic and organic chemistry, mineralogy, metallurgy, biochemistry—all with special reference to crystal structure. F. I. G. R.

See also Abstracts 3325, 3423, 3439, 3476, 3512, 3553, 3560, 3641, 3643, 3650, 3652, 3653, 3655.

DENSITY.

3286. Curvature of the Diameter of Densities. É. Mathias. *Comptes Rendus,* 200. *pp.* 1902–1905, *June* 3, 1935.—The curvature (C) of the diameter of densities $y = D_0 + \alpha t + \beta t^2 + \gamma t^3$ is given by $C = 2\beta + 6\gamma t$. Values of β, γ, the point of inflexion of the diameter, and the critical temperature are tabulated for methyl, ethyl and propyl alcohol, and for CO. Value of C for 29 compounds are tabulated and their significance is discussed. [See **Abstract 3110 (1935)**.] J. S. G. T.

3287. Micromethod for Estimation of Heavy Water. H. Perperot and F. Schacherl. *J. de Physique et le Radium,* 6. *pp.* 319–322, *July,* 1935.—Difficulty having been found in determining the temperature at which the float in Goldfinger and Scheeper's method [see Abstract 2728 (1934)] is in equilibrium with the liquid a method is described in full detail with example, depending on the determination of the rate of ascent or descent of the float at temperatures slightly below or above that of equilibrium. C. A. S.

See also Abstract 3328.

DIFFUSION AND OSMOSIS.

3288. Diffusion Coefficients of Molecules and Ions. W. G. Eversole and E. W. Doughty. *J. Phys. Chem.* 39. *pp.* 289–292, *Feb.,* 1935.—Mathematical. A diffusion equation is built up on the assumption that if diffusing particles be present initially only in a given plane in a medium, their subsequent positions are governed by probability curves of the usual Gaussian form. The values of the diffusion coefficient so obtained are (i) for unchanged molecules, $D_m = X^2/4t(\log_e m_0 - \log_e m_1)$, (ii) for charged particles, $D_i = D_m(1 - 2UEt/X^2)^2$, in which D_m, D_i are the diffusion coefficients for molecules and for ions, m_0 is the maintained concentration of diffusibles in the reference plane, t is the time required for the concentration to reach a value m_1 at distance X (such that, *e.g.*, an indicator is just affected), U is the mobility of the ions and E the diffusion potential of the ions. L. V. C.

3289. Diffusibility of Deuterium in Metals. T. Franzini. *Accad. Lincei, Atti.* 21. *pp.* 577–580, *April* 28, 1935.—Since it is known that H_2 is readily occluded by Pd, this metal is used in an attempt to discover if D_2 also diffuses through metals. The experiment, which depends for solution on spectroscopy and micro-photometry again shows that occluded H_2 is displaced by an electric field, but gives no support to an analogous effect for D_2. H. M. B.

3290. Sudden Change in Permeability of Pd to H_2. V. Lombard and C. Eichner. *Comptes Rendus*, 200. *pp.* 1846–1848, *May* 27, 1935.—When H_2 at 760 mm. diffused through a plate of commercial Pd 0·074 mm. thick into a vacuum, 99·95 % of the diffusing power was lost on cooling the plate from 225° to 125°, the loss occurring almost entirely near 180°. The power was recovered on heating to about 190°. A plate of pure Pd 0·259 mm. thick behaved similarly save that the changes occurred a few degrees lower. C. A. S.

3291. Anomalous Diffusion in True Solution. H. Freundlich and Deodata Krüger. *Faraday Soc.*, *Trans.* 31. *pp.* 906–913, *July*, 1935.—Anomalies of diffusion, such as are found, for instance, when quinone is diffusing in aqueous solutions of electrolytes, may be explained as follows: the existence of a concentration gradient (of the quinone) in the aqueous solution from the outset may cause the uniformly distributed substance also to diffuse, owing to a mutual change in solubility of the two solutes (G. S. Hartley). In consequence, in the course of the diffusion process, a thin layer of the liquid on the border line of the two solutions may become less dense than the solution above, and this inadmissible density gradient may produce convection currents disturbing the normal process of diffusion. The correctness of this assumption was proved by the fact that the anomalies disappeared when care was taken that the solution above was to a sufficiently marked degree less dense than the one below. AUTHORS.

See also Abstract 3559.

ELASTICITY AND PLASTICITY.

3292. Stresses in Rotating Discs of Varying Thickness. B. Sen. *Phil. Mag.* 19. *pp.* 1121–1125, *June*, 1935.—Expressions are found for the average radial and hoop stresses in thin rotating discs for the cases in which the thickness $2h$ is related to the distance r from the centre by the equations $h = h_0 e^{-kr}$ and $h = h_0\left(1 - \frac{r^2}{b^2}\right)$, where h_0, k and b are constants. G. E. A.

3293. Theory of Elastic Reaction. P. Vernotte. *Comptes Rendus*, 200. *pp.* 2058–2061, *June* 17, 1935.—It is suggested that the properties of elastic materials are such that the return to the position of equilibrium after deformation is the result of opposed distributions of elasticity and viscosity. G. C. McV.

3294. Elastic Moduli of Ferromagnetic Materials. M. Kersten. *Zeits. f. Metallkunde.* 27. *pp.* 97–101, *May*, 1935.—A summary is given of recent theoretical results on the influence of internal strain on the elastic moduli of ferromagnetic materials, on their variation with temperature, and on the relation between the elastic moduli and the extent of drawing. The effect of magnetisation is considered both theoretically and practically. J. T.

3295. Theory of the Photoelastic Effect of Cubic Crystals. H. Mueller. *Phys. Rev.* 47. *pp.* 947–957, *June* 15, 1935.—The theory of Ewald and Born of the double refraction of crystals is applied to the calculation of the photoelastic properties of D lattices. Only in special cases, as for instance in KCl for pressure parallel [111], is the effect determined by the anisotropy of the Lorentz and Coulomb forces. In these cases the photoelastic data determine the ratio R_{Cl}/R_K of the ionic refractions. Satisfactory agreement with all observations can be reached by assuming that the elastic deformations produce optical anisotropy of the atoms. Introducing this assumption in the Ewald-Born theory leads to an explanation of the change of the index of refraction with the density, and of the different photoelastic properties of NaCl, KCl, CaF_2 and diamond. The photoelastic constants of other crystals are predicted. It is shown that the "cavity" method of Lorentz and Bragg gives the same Lorentz force as the theory of Born and Ewald. The calculations of the photoelastic effect by Herzfeld and Banerjee are incorrect and incomplete. AUTHOR.

3296. Effective Cross-Section of Pressure Gauges and Compressibility of Solids up to 5000 kg./cm.^{2}. H. Ebert. *Phys. Zeits.* 36. *pp.* 385–392, *June* 1, 1935.—The effective cross-section of a leaky piston moving in a cylinder is measured by a differential balance so that when loaded either directly or by a system of levers, pressures up to 5000 kg./cm.^{2} may be recorded by this piston manometer. A comparator method is used to measure the compression in mono-crystalline iron, gold, silver, lead, aluminium and magnesium, and in poly-crystalline copper, manganin and steel. The pressure is measured by a resistance manometer analogous to a resistance thermometer. Compressibilities are given in mm./m. for different pressures, and the decrease in length per unit change in pressure is calculated; this is found to be nearly constant.

H. M. B.

See also Abstracts 3305, 3334, 3584, 3614, 3670.

GRAVITATION.

3297. Centres of Gravitation and Centrobaric Bodies. A. Fenici. *Accad. Lincei, Atti,* 21. *pp.* 493–498, *April* 7, 1935.—Levi-Civita has called centre of gravitation of a body every point in which the Newtonian attractions of the single elements of the body are in equilibrium. The author indicates some properties of these centres, commencing by proving their existence. The notion of a centrobaric body due to Kelvin is considered. If a body is centrobaric, not only in the external field but also in the internal points, it is necessarily bounded by concentric spherical surfaces, and cannot be other than a sphere if it has a single contour. J. J. S.

See also Abstracts 3369, 3370.

HYDRODYNAMICS AND AERODYNAMICS.

3298. Waves of Permanent Type in Heterogeneous Liquids. M. L. Dubreil-Jacotin. *Accad. Lincei, Atti,* 21. *pp.* 344–346, *March* 3, 1935.—In a previous note [see Abstract 3529 (1932)] it was shown that it is impossible to propagate a barotropic wave (*i.e.*, one for which the lines of constant pressure and density coincide with the lines of flow) in a heterogeneous liquid of finite depth; and that Gerstner waves were possible solutions in the case of infinite depth. It is here shown that the Gerstner waves is the only possible barotropic solution. A. J. McC.

3299. Divergent and Convergent Flows of a Viscous Fluid. A. Miyadzu. *Tohoku Univ., Technol. Reports*, 11. 4. *pp.* 17–72, 1935.—The velocity and the pressure of a viscous incompressible fluid flowing very slowly between fixed walls having the form of a logarithmic spiral are determined; it being assumed that the motion is steady, two-dimensional, and free from the action of external forces. It is shown that for viscous flow the velocity and pressure have complicated relations with reference to the divergence and the curvature of the boundary, and the sense, outward or inward, of the flow, while, for a perfect fluid, the velocity is a function of the radius from the origin only and the pressure is a function of the velocity. The practical details of the investigations are then given, together with the conclusions reached for radial and spiral flow. The divergent-convergent flows of a viscous fluid based on the same assumptions are studied so as to compare the results with those for the potential flow of a perfect fluid without the same form of stream lines, and with the results previously obtained. G. F. P. T.

3300. Velocity of Fall of Solid Spheres through a Viscous Fluid. M. Ghali. *Comptes Rendus*, 200. *pp.* 2155–2157, *June* 24, 1935.—With the object of studying the movement of particles in suspension in the water of the Nile or deposited in the irrigation canals, the velocity of fall of a sphere through a fluid has often to be determined. A description is given of a method which has the advantage of eliminating the disturbances produced by the use of registering apparatus placed inside the fluid. It consists of recording the passage of a sphere, of several spheres or a cloud of particles, by occultation of two converging pencils of rays, directed towards a photoelectric cell, which define the distance fallen. The transit of the sphere through the region determined by the pencils produces variations in the electric current, which are registered, after amplification, on a photographic paper drawn along by a motor. The times recorded are accurate to 0·001 sec. G. F. P. T.

3301. Viscosity Effects in a Channel of Small Exponential Divergence. G. N. Patterson. *Canad. J. of Research*, 12. *pp.* 676–685, *May*, 1935.—An experimental investigation of a flow form, deduced by Blasius from theoretical considerations, was carried out with air as the medium. A photographic method of measuring velocity distributions was adopted, and a diverging channel was designed from considerations based on the theoretical treatment and on requirements arising out of the experimental method. At a Reynolds number of 35, curves of velocity distribution were measured at various positions along the channel, and comparisons were then made with the corresponding theoretical curves. Good agreement was found over the region of the channel to which the theoretical results could be applied. A study of the experimental curves in that part of the channel to which the theoretical results could not be applied quantitatively showed further that the general flow characteristics described by Blasius are to be found in this region. [See Abstract 588 (1935.)] AUTHOR.

KINETIC THEORY OF MATTER.

3302. New Form for the Equations of Dynamics of a Gas. S. de Backer. *Comptes Rendus*, 200. *pp.* 1913–1915, *June* 3, 1935.—The equation of transfer of the quantity $u^{\alpha} u^{\beta}$ (where the u^{α} are the components of velocity of a molecule of the gas) is transformed by making special assumptions for the form of the function representing the collisions of the molecules and for the symmetric third rank tensor of velocities. Maxwell's law of force is not used. The law of heat-conduction for a monatomic gas is easily deduced from the transformed equation and other results are also found. G. C. McV.

3303. Stokes Phenomenon in the Problem of Inelastic Atomic Collisions. O. K. Rice. *J. Chem. Phys.* 3. *pp.* 386–398, *July*, 1935.—The probability of energy exchange in inelastic atomic collisions may be shown to depend upon the connections between the solutions for values of r, the distance between the atoms, which correspond to regions of space where the relative kinetic energy of the two atoms is positive and the solutions for values of r corresponding to regions where the kinetic energy is negative. The finding of these connections involves a study of the asymptotic forms of the solutions when these forms are considered as functions of a complex variable. Such a study has been made in this paper, and the corresponding Stokes phenomenon investigated. The desired end was not achieved, but results of interest have nevertheless been obtained. A brief discussion is given of the previous work of Stueckelberg [see Abstract 1323 (1933)]. AUTHOR.

See also Abstracts 3467, 3490, 3491, 3564.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***3304. Portable Chemical Balance. H. Lloyd.** *Journ. Sci. Instruments*, 12. *pp.* 222–224, *July*, 1935.—Constructional details are given of a simple design of miniature spring balance for weighing out small samples of material required for analysis. The instrument is portable, permits rapid weighings to be made, and has proved entirely satisfactory in use. AUTHOR.

See also Abstract 3425.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3305. Functions Analogous to the Potential in Mathematical Physics. L. Sobrero. *Accad. Lincei, Atti*, 21. *pp.* 448–454, *March* 17, 1935.—The ordinary potential function in mathematical physics appears as an auxiliary function whose gradient gives the unknown functions required in the solution of a problem and whose introduction simplifies the solution. The author shows that a function analogous to the potential can be introduced in any problem which involves the solution of a number of linear partial differential equations in the unknown functions, so that the problem reduces to the solution of a partial differential equation in one unknown function. As applications he gives two examples: the function of Marguerre in a problem of plane elastostatics, and also the function arising in the equations of motion in plane elastodynamics. The new functions simplify considerably the problems in question. A. J. McC.

3306. Thermal Units, Electrical and Magnetic Units, and Thermodynamic Symbols. *International Conference on Physics, London*, 1934. *Reports on Symbols, Units and Nomenclature, pp.* 1–25, *Physical Society.*

3307. Definitions of Magnetic Magnitudes. H. Abraham. *International Conference on Physics, London*, 1934. *Reports on Symbols, Units and Nomenclature, pp.* 26–37, *Physical Society.*—It is possible to describe all magnetic phenomena as due to the action of atomic currents, without the introduction of any other notion than that of magnetic induction. At any point of a magnetic body, a distinction is drawn between the induction due to distant currents, which varies gradually from point to point, and the induction produced by local currents to which are due the rapid changes of the total induction in the neighbourhood of these local currents ; we are thus led to consider the mean total induction at a point (a vector B_2) which is the sum of the mean induction due to all the local currents (a vector B_1), and the induction due to distant currents (a vector B_0). The vector B_2 is usually denoted by B and called magnetic induction, and the vector B_0, for which the name magnetising induction is suggested, is usually denoted by H. P. V.

3308. Force Between Two Elements of Current. P. Vigoureux. *International Conference on Physics, London,* 1934. *Reports on Symbols, Units and Nomenclature. pp.* 38–40, *Physical Society.*—The well-known theorem that the force on an element *ds′* of a closed circuit S′ carrying a current *i′* can be represented by i' B sin $\psi\, ds'$, where B is the induction at *ds′* due to current in a circuit S, and ψ is the angle between *ds′* and the direction of B, is deduced directly from Ampere's expression for the force between two elements of current. P. V.

***3309. Differential Analyser. D. R. Hartree.** *Nature,* 135. *pp.* 940–943. *June* 8, 1935.—The machine described consists of a number of units which can be connected to shafts which drive them or are driven by them. These shafts can be connected together by gearing in various ways so that the relations between the rotations of the different shafts satisfy various differential equations. The details of the construction, the method of operation, and a general view of the machine are given. Typical applications of its use are for (1) atomic structure and properties, (2) transients in electrical circuits containing elements with non-linear characteristics, (3) performance of automatic control mechanism, (4) propagation of radio waves in the Heaviside layer, regarded as a stratified medium, (5) vibrations of systems with non-linear restoring forces, (6) paths of electrified particles in the field of a magnet, *e.g.*, aurora and cosmic radiation, and (7) equilibrium and stability of stellar structure. R. S. R.

See also Abstracts 3312, 3537, 3668.

MECHANICS, CLASSICAL.

3310. Characteristic Exponents of the Equilibrium Configuration of a Dissipative System. R. Einaudi. *Accad. Lincei, Atti,* 21. *pp.* 336–343, *March* 3, 1935.—The stability or instability of the equilibrium configuration of a dynamical system can in general be deduced from the nature of the characteristic exponents, that is, of the roots of the characteristic determinantal equation. The present paper shows that the stability or instability of a dynamical system, which in addition to conservative forces is acted upon by dissipative forces derived from a positive definite quadratic form, can be deduced from the stability or instability of the system under the action of the conservative forces only. In particular, the following theorem is obtained : the number of degrees of instability which an equilibrium configuration possesses in the absence of dissipative actions remains unaltered when dissipative forces are added to the system. A. J. McC.

See also Abstract 3292.

MECHANICS, QUANTUM.

3311. Quaternions, Semi-Vectors and Spinors. J. Blaton. *Zeits. f. Physik*, 95. 5–6. *pp.* 337–354, *June* 17, 1935.—The representation of Lorentz transformations by quaternions provides a simple method for developing the theory of semi-vectors and spinors. The decomposition of semi-vectors and spinors into two types is shown to correspond to the division of quaternions into two invariant sub-algebras. The geometrical representation of the method is also discussed. G. C. McV.

3312. Exact Solutions of the Schrödinger Equation. M. F. Manning. *Phys. Rev.* 48. *pp.* 161–164, *July* 15, 1935.—A method is given for determining the forms of potential function which permit an exact solution of the one-dimensional Schrödinger equation in terms of series whose coefficients are related by either two or three term recursion formulæ. The more interesting expressions for the potential energy have been tabulated. A correspondence is found between these solutions and the solutions of the corresponding Hamilton-Jacobi equation. It is shown that whenever the Hamilton-Jacobi equation is soluble in terms of (*a*) circular or exponential functions, or (*b*) elliptic functions, the corresponding Schrödinger equation is soluble in terms of a series whose coefficients are related by (*a*) a two-term, or (*b*) a 3-term recursion formula respectively. For the first case the quantised values of the energy are found by restricting the series to a polynomial and in the second by finding the roots of a continued fraction. A brief discussion of the technique of solution of continued fractions is given. AUTHOR.

3313. Differential Equation in Wave Mechanics. K. Basu. *Indian Phys. Math. J.* 6. *pp.* 9–13, *April*, 1935.—A differential equation found in a former investigation [see Abstract 2763 (1934)] is solved under special conditions, and results are discussed. N. M. B.

3314. Quantisation under Two Centres of Force. S. K. Chakravorti. *Indian Phys. Math. J.* 6. *pp.* 31–38, *April*, 1935.—The eigen-value in the wave equation for quantisation under two centres of force is calculated to a very close approximation by a method free from arbitrary assumptions, and leads to a Ritz-type formula for the energy value. The expressions obtained give two sequences of energy levels and two sequences of spectral lines, no intercombination of energy levels being possible. The ortho and para type of molecule or ion correspond respectively to the two sequences. N. M. B.

3315. Calculations of Atomic Wave Functions. Part IV. Results for F$^-$, Al^{+3}, and Rb$^+$. D. R. Hartree. *Roy. Soc., Proc.* 151*A*. *pp.* 96–105, *Aug.* 1, 1935.—In continuation of the plan for making generally available the results of calculations of atomic wave functions by the method of the self-consistent field, results for F$^-$, Al^{+3}, and Rb$^+$ are here presented. [For Part III see Abstract 1989 (1935).] AUTHOR.

3316. Statistical Mechanics and the Equilibrium of Matter and Radiation. G. Allard. *Comptes Rendus*, 201. *pp.* 39–41, *July* 1, 1935. —The statistical method already developed [see Abstract 4448 (1934)] is extended to include the possibility that the *a priori* probability of a phase-cell containing *k* particles itself depends on *k*. It is shown that particular cases give the Einstein-Bose, Fermi-Dirac and classical Boltzmann statistics. Conversely, starting from the partition law for the equilibrium of matter and radiation, it is found that the *a priori* probability for this case has a value which becomes infinite with *k*. G. C. McV.

See also Abstracts 3209, 3239, 3303, 3464, 3465, 3466, 3498, 3564, 3572, 3612, 3636, 3642, 3662.

RELATIVITY AND ETHER.

3317. Deduction of the Lorentz Transformation. L. R. Gomes. *Accad. Lincei, Atti,* 21. *pp.* 433–437, *March* 17, 1935.—In most of the deductions of the Lorentz transformation, in addition to the hypotheses of the invariance of the velocity of light and of the physical equivalence of the two systems concerned, there is another hypothesis imposed in order to ensure the linearity of the transformation. This last hypothesis can be dispensed with and a proof of the transformation is here given which involves only the following assumptions : (i) one observer is moving with uniform velocity relative to the other, (ii) light has the same constant velocity relative to each observer, (iii) the laws of physical phenomena have the same form in each system (the principle of relativity).
A. J. McC.

3318. Significance of the Jena Michelson Experiment. Part II. L. Baumgardt. *Ann. d. Physik,* 23. 2. *pp.* 105–110, *June,* 1935.—The author seeks to disprove the necessity of the Lorentz contraction. [For Part I see Abstract 1006 (1935).] G. C. McV.

3319. Simultaneity and Relativity Theory. K. Vogtherr. *Zeits. f. Physik,* 94. 3–4. *pp.* 261–276, *March* 19 ; 94. 11–12. *pp.* 785–800, *May* 3, *and* 95. 3–4. *pp.* 227–242, *June* 4, 1935.—It is pointed out that if the basal assumption of relativity theory is not made, *viz.*, that synchronising of clocks at different places is to be made either by slow transport of a clock or by light signals, then it is possible to give an absolute meaning to simultaneity at different places. The methods by which this is to be done involve the use of ideal rigid bodies. Thus it is claimed that simultaneity at different places is part of the idea of time : relativity theory is therefore false since it denies this. Other considerations are also put forward which claim to show that the theory is in conflict with the characteristics which reality must necessarily possess. G. C. McV.

3320. Aspects of Relativity Theory. Part I. J. v. Weyssenhoff. *Zeits. f. Physik,* 95. 5–6. *pp.* 391–408, *June* 17, 1935.—The author gives his views regarding methods for basing relativity theory on physical intuitions and illustrates his ideas by interpretations of general linear coordinates in special relativity. G. C. McV.

3321. Einsteinian Motion and Principles of Equivalence. M. Cimino. *Accad. Lincei, Atti,* 21. *pp.* 347–352, *March* 3, 1935.—Levi-Civita has given two principles of equivalence by means of which the Einsteinian motion of a particle in a gravitational field produced by a statical distribution of mass is given to the second order of approximation by the Newtonian motion of a particle in a suitable field of force. The author uses these principles to study the Einsteinian motion of a planet round the sun [see Abstract 1995 (1935).] A. J. McC.

3322. Particle Problem in the General Theory of Relativity. A. Einstein and N. Rosen. *Phys. Rev.* 48. *pp.* 73–77, *July* 1, 1935.—The writers investigate the possibility of an atomistic theory of matter and electricity which, while excluding singularities of the field, makes use of no other variables than the $g_{\mu\nu}$ of the general relativity theory and the ϕ_μ of the Maxwell theory. The theory involves the mathematical representation of physical space by a space of two identical sheets, a particle being represented by a " bridge " connecting these sheets. It explains why no neutral particles of negative mass are to be found. The most natural elementary charged particle is found to be one of zero mass. The many-particle system is expected to be represented by a regular solution of the field equations corresponding to a space of two identical sheets joined by many bridges. In this case, because of the absence of singularities, the field equations determine both the field and the motion of the particles. The many-particle problem, which would decide the value of the theory, has not yet been treated. AUTHORS.

3323. Macroscopic Theory of Fields. J. Mariani. *Comptes Rendus*, 200. *pp*. 2009–2011, *June* 12, 1935.—The laws of nature should express the geometric properties defining the scale and not the physical properties characterising material systems. A mathematical theory embodying this conception is briefly sketched. The application of the theory of groups of motion will lead to the derivation of the law of gravitation and afford a simple interpretation of the laws of electromagnetism [see Abstract 2316 (1932)]. J. S. G. T.

3324. Unified Field Theory and Non-Holonomic Hypersurfaces. G. Vraceanu. *Comptes Rendus*, 200. *pp*. 2056–2058, *June* 17, 1935.—A non-holonomic hypersurface is defined as the set of invariants common to a four-dimensional Riemannian metric $ds^2 = aij\ dx^i\ dx^j = \sum_{r=1}^{4} (ds^r)^2$, (where the ds^r are Pfaffian forms in the co-ordinates), and to the Pfaffian equation $dx^5 - \phi_i\ dx^i = 0$ (where the ϕ_i are components of the electromagnetic vector potential). The unified field-theory of Einstein and Mayer [see Abstract 2227 (1933)] is obtained by fixing one of the normals to the hypersurface. The tensors belonging to the hypersurface are described and their physical interpretation given. G. C. McV.

See also Abstracts 3344, 3537, 3662, 3663, 3664.

SOLUTION.

3325. Molecular Solid Solutions in Cu–Au System. N. W. Ageew and D. N. Shoyket. *Ann. d. Physik*, 23. 1. *pp*. 90–104, *May*, 1935.—This investigation deals with the solid solutions formed by AuCu and $AuCu_3$ with excess of their components. The structures of AuCu and of $AuCu_3$ are found to be those of 2 lattices in which one is surrounded by Au and the other by Cu atoms. The results indicate that in alloys whose composition is near to that of AuCu, no complete arrangement of the atoms occurs. For AuCu the degree of atomic order is $\alpha = 0{\cdot}89$, and for $AuCu_3$, $\alpha = 0{\cdot}92$, *i.e.*, about 10 % of the atoms are not in their correct positions and the deviation is ascribed to the thermal condition. Addition of excess atoms to the compounds still further increases the lack of order. An equilibrium is established between the atomic distribution in the Au and Cu lattices which is dependent upon temperature. Neither compound forms an uninterrupted mixed-crystal series. The forms of the property-composition and degree of order-composition curves are analogous, thereby confirming the theoretical deductions. H. H. Ho.

See also Abstracts 3246, 3328.

SURFACE TENSION AND COHESION.

3326. Orientation of Unsymmetrical Molecules at Interfaces. S. H. Bauer and A. Pollack. *J. Chem. Phys*. 3. *pp*. 401–405, *July*, 1935.—A function giving the distribution of the angles of orientation of the molecular axes from the normal to the interface can be obtained by making use of a number of special assumptions regarding the forces

of orientation. This is compared with the distribution calculated on assuming an extreme form of Langmuir's principle of independent surface action. The importance of having such a function is pointed out.
AUTHOR.

3327. Correction to the Eötvös Constant. D. G. Dervichian. *Comptes Rendus*, 200. *pp.* 2065–2067, *June* 17, 1935.—In the Eötvös equation $(M/\rho)^{2/3}$ represents a surface area, and $(M/N\rho)^{2/3}\gamma$ represents surface energy per molecule. X-ray study of the fatty acids has shown that while the length of the molecule increases regularly with the number of atoms, the cross-section σ of the molecule is constant. By the substitution of determined values of σ for $(M/N\rho)^{2/3}$ values of K are obtained which approximate either to 1 or 2, whatever the value of K calculated in the usual manner. Myricyl alcohol and tristearin are striking examples. $K = 2$ for some elements and diverse organic substances. $K = 1$ for substances with asymmetrically polarised molecules. A further paper will deal with this feature. P. H. B.

3328. Surface Tensions and Partial Vapour Pressures of Aqueous Aniline Solutions. J. C. Speakman. *Chem. Soc., J. pp.* 776–779, *June*, 1935.—Gibbs' adsorption theorem leads to an unexpectedly high value (28·5 Å^2) for the minimum area occupied by an aniline molecule in the surface of its aqueous solution. This was thought to be due either to errors in the surface tension data, or to the failure of the assumption that the concentrations and activities of aniline are identical. Surface tensions were redetermined by a capillary method [see Abstract 78 (1934)], and two sets of observations with different apparatus agreed to ± 0·2 dyne/cm. and agree approximately with those of Seith, disgreeing with those of Warley. Densities were also determined. Partial vapour pressures were redetermined by a gas saturation method, the results being reproducible to within 2 %. The solubility of aniline in water at 20·0° C. was found to be 0·385 mol. When Henry's law ceases to apply to the partial vapour pressure of aniline it is no longer permissible to use concentrations for activities, and the adsorptions formerly calculated are incorrect. A new set of figures is given and discussed. P. H. B.

3329. Surface Tensions of Viscous Tars and Bitumens. A. Léauté. *Comptes Rendus*, 201. *pp.* 41–43, *July* 1, 1935.—The surface tensions of these substances were measured by means of capillary tubes. Sufficient time was allowed for the column of liquid to reach its equilibrium height. In one case 360 hr. was allowed. The results were between 6·5 and 7·8 mg./mm. These values are approximately double those obtained by Nellensteyn and Roodenburg, who used the bubble pressure method, and they do not conform with Dubrisay's finding by means of drops in water that the interfacial tension is in inverse order with the viscosity. It is suggested that only truly static methods can give correct results for such viscous substances. Detailed results will be published elsewhere. P. H. B.

3330. Maximum Volume of Vapour Bubbles. W. Fritz. *Phys. Zeits.* 36. *pp.* 379–384, *June* 1, 1935.—The tables of Bashford and Adams are applied to find the volume of a bubble of vapour formed on a flat surface. Curves between volume and diameter show that (*a*) there is a maximum value after which the bubble bursts and (*b*) for each diameter there can be two volumes. A general dimensionless equation is obtained for the maximum volumes of gas and vapour bubbles depending upon the angle of contact. H. M. B.

3331. Films Built by Depositing Successive Monomolecular Layers on a Solid Surface. Katharine B. Blodgett. *Am. Chem. Soc., J.* 57. *pp.* 1007–1022, *June*, 1935.—A method is described for producing films consisting of definite numbers of monomolecular layers of soaps on glass, polished Cr, Ni, Fe, Ag, Pt, steel, or brass. The slide is aternately raised from and dipped into an aqueous solution of suitable *p*H on the surface of which a monomolecular film is maintained under suitable (two-dimensional) pressure. Two varieties of film are obtained according to the *p*H of the solution, one (Y) in which layers are deposited on both raising and lowering the slide, the other (X) with films deposited only when the slide is lowered. Measurements of the thickness of these films indicate for the long spacings values slightly greater than result from other methods (X-ray, etc.). A method of determining the refractive index by means of the polarising angle is described, giving $n = 1\cdot470_5$, $1\cdot462$ and $1\cdot482$ for Ca and Ba stearates and stearic acid respectively. C. A. S.

3332. Dielectric Potential at a Solution-Air Interface. B. Kamieński. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A. pp.* 129–136, *March–April*, 1935. *In English.*—Full particulars are given of a dynamical jet method of gauging dielectric potentials on a solution-air interface. The method is advisable for the measuring of weak and strong potentials of very active substances in solution. Numerous measurements are cited, namely, the potential of 0·01 *M* quinine hydrochloride at different H-ion concentrations. The influence of the H-ion concentration is marked and a diagram shows some turning points at pH 4·15, 5·6 and 6·8. At lower H-ion concentrations the potential is higher than at greater concentrations. It amounts to 55 mV at pH 2·2 and to 464 mV at pH 7 in a 0·01 *M* quinine hydrochloride solution. The potential is 175 mV in a 0·001 *M* quinine hydrochloride solution at the H-ion concentration of blood. AUTHOR.

***3333. Principal Cause of Inferiority of Spirit Levels. L. Dunoyer.** *Comptes Rendus,* 200. *pp.* 1836–1838, *May* 27, 1935.—The paper explains mathematically, assuming the classical theory of Laplace, why the precision spirit level is so sensitive to small differences of temperature between the ends of the bubble and to temperature gradients caused by very slight draughts. The inferiority of the bubble level is not due to the free surface within the bubble being less accurately horizontal, but is due to the fact that it is not the normal to this surface which is observed, but the positions of the ends of the bubble. J. S. C.

See also Abstracts 3204, 3207, 3336, 3337.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 3339.

VACUA, HIGH.

***3334. Absolute Manometer for Pressures from 0·001 Micron to 1 Atmosphere. E. B. Baker and H. A. Boltz.** *Rev. Sci. Instruments,* 6. *pp.* 173–174, *June*, 1935.—The instrument consists of a McLeod type of gauge, in which the mercury column is raised by pressure instead of lifting a reservoir. The necessary pressure is produced by a bicycle pump, and the method has the advantage that no rubber need be used. The gauge must be of barometric height and thus affords means of measuring high pressures. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

3335. Measurement of Absolute Internal Friction by the Pendulum Viscometer. B. W. Iliin and W. N. Iwanow. *Kolloid Zeits.* 71. *pp.* 265–267, *June*, 1935.—The pendulum viscometer previously described [see Abstract 2832 (1933)] for measuring internal friction in disperse systems can also be employed with fair accuracy for the determination of absolute internal friction in homogeneous liquids. C. B. A.

3336. Physical Properties of Surfaces. Part I. Kinetic Friction. W. G. Beare and F. P. Bowden. *Roy. Soc., Phil. Trans.* 234*A*. *pp.* 329–354, *June* 6, 1935.—A method is described for the measurement of kinetic friction between highly polished surfaces. With unlubricated surfaces the coefficient of kinetic friction μ_K is independent of the load, of the area of contact and of the velocity. The presence of contaminating films on the surface can give apparent deviations from these relationships. With lubricated surfaces a transition from " fluid lubrication " to " boundary lubrication " is shown and in the latter state μ_K is again independent of the velocity and of the area of contact. With some lubricants μ_K decreases with increasing load, with others it is constant. No " latent period " was found for kinetic friction. The effect of chemical composition on μ_K is investigated for homologous series of hydrocarbons, alcohols and acids. Kinetic friction measurements between dissimilar surfaces show no evidence for a mean value rule. [See following Abstract.] AUTHORS.

3337. Physical Properties of Surfaces. Part II. Viscous Flow of Liquid Films. Range of Action of Surface Forces. S. H. Bastow and F. P. Bowden. *Roy. Soc., Proc.* 151*A*. *pp.* 220–233, *Aug.* 1, 1935. —A method is described for measuring the viscosity of very thin liquid films, about 10^{-5} cm. up to any desired thickness. Thin films of a dilute solution of a liquid crystal show a pronounced rigidity, but there is no sign of an induced structure in normal liquids. Thin films of water, cyclohexane, alcohol, acetic acid, ethyl palmitate, and lithium chloride solution all behave as perfect fluids even when cooled to within 0·1° C. of the freezing point. Within the limits of accuracy the viscosity of the film is the same as that of the liquid in bulk. No evidence can be found for rigid oriented chains of molecules extending from the surface to a distance of 1500 Å to 50,000 Å as reported. If these oriented chains exist, their length is certainly under 1000 Å and probably very much less. [See preceding Abstract.] AUTHORS.

3338. Influence of an Electrical Field on the Viscosity of Fluids. S. Dobiński. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 42–52, *Jan.–Feb.*, 1935. *In German. Phys. Zeits.* 36. *pp.* 509–513, *July* 15, 1935. —It is shown that the experimental data obtained by certain previous workers on the influence of an electrical field on the viscosity of fluids and on ionic movement have to be discarded. This effect diminishes with progressive purification of fluids usually up to complete disappearance, and conversely with progressive lack of purity for certain admixtures a certain limit is reached. This depends as much on the type of solvent as on the kind of solute and occurs only in polar solvents. It appears that for aliphatic solvents the viscosity increases in an electrical field, while conversely for aromatic solvents the viscosity decreases. Measurements in fields of different intensities show that the effect is proportional to the square of the electrical field. With alternating fields no measurable effects are found for any solvents. J. K.

See also Abstracts 3584, 3619, 3654.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

✱3339. Shortt Clock of Lick Observatory. H. M. Jeffers. *Lick Observat., Bull. No.* 468. *pp.* 75–79, *April* 5, 1935.—The run studied covers six years to Jan., 1935. Until 1931 conditions were unfavourable ; since then there have been no air leaks and pressure within the case diminished 4 mm. The effects of local and more distant earthquakes are studied. Temperature changes, due to failure of power supply, etc., have been troublesome, due to instabilities in the invar rod. A novel photographic apparatus for the measurement of the pendulum arc is described ; four records are made per day ; the resulting formula for the rate is studied. The residuals show no discontinuity until a failure in the thermostatic control occurred ; the discontinuity at that point is very marked and six months were required for return to a normal state. The behaviour of invar in such conditions requires further study. Directions for further improvement are briefly discussed. T. L. M.

✱3340. Slitless Spectrograph for the Greenwich Observatory 36-in. Reflector. J. H. Dowell. *Journ. Sci. Instruments*, 12. *pp.* 224–225, *July*, 1935.—A slitless spectrograph for the determination of the colour-temperature of stars by the relative distribution of intensity over the spectrum is described. A single prism of 45° and 6-in. aperture is employed and a camera consisting of a concave mirror of 36-in. focus. Uniform linear motion is imparted to the plate-holder by an a.c. induction motor in order to lengthen the spectrum lines with uniform intensity. AUTHOR.

✱3341. Ultra-Violet Stellar Spectra with Aluminium-Coated Reflectors. Part III. R. W. Shaw. *Astrophys. J.* 82. *pp.* 87–94, *July*, 1935.—The wave-lengths of 118 absorption lines in the spectrum of α Lyrae between λ 3000 and λ 3480 have been measured. Seventy-four of the lines have been identified with the spectra of the once ionised atoms Al, Cr, Fe, Mn, Ti, and V, and with spectra of the neutral atoms Al, Fe, and Na. Some of the lines appear to have variable intensities. No lines were observed between λ 3480 and the Balmer limit at λ 3646. The lines of Ti^+ are particularly prominent. It is shown that the ultra-violet lines of this atom as observed in α Lyrae involve the same energy levels, or others of comparable excitation potential, as do known Ti^+ lines in the visible region. On this basis one might expect lines in the region $\lambda\lambda$ 3480–3646. The absence of lines in this region is discussed in terms of the hydrogen continuum and the ultra-violet energy-curve. [For Part II see Abstract 3573 (1934).] AUTHOR.

See also Abstracts 3365, 3433.

COMETS AND METEORS.

3342. Ephemeris of Radiant Point of Eta Aquarid Meteor Stream. R. A. McIntosh. *Roy. Astron. Soc., M.N.* 95. *pp.* 601–605, *May*, 1935.—Diagrams exhibit the maximum in the horary rate for May 4–5, and the effect of the Aquarids on sporadic meteors' horary rates. Tables are given of radiant-points and an ephemeris for these [see

Abstract 2782 (1934)] which shows that the radiant-point of the stream is in motion, the daily movement being 0°96 in R.A., and 0°37 in Dec. An elliptical orbit is calculated for the stream, which indicates a clear connection with the orbit of Halley's comet. A. S. D. M.

COSMOGONY.

3343. Einstein's Cosmological Constant and the Connection Between Atomic and Cosmical Constants in the Expanding Universe Theory. H. Ertel. *Preuss. Akad. Wiss., Berlin, Ber.* 1. *pp.* 3–7, 1935.—Using the equations of the expanding universe and a modification of Eddington's equation for the fine-structure constant, the author deduces that the cosmical constant can be interpreted as the square of the ratio (in appropriate units) of the gravitational and Coulomb forces in the interior of the H atom. G. C. McV.

3344. Stellar Kinematics and the K-Effect. E. A. Milne. *Roy. Astron. Soc., M.N.* **95.** ***pp.*** **560–573,** ***May,*** **1935.**—Oort's method of analysing relative stellar velocities for differential galactic rotation is generalised for any distribution of velocities on the lines of Stokes's analysis of the differential motion of an element of a fluid. It is shown that, whatever the velocity-distribution, there will be in general a non-zero K-effect, a non-zero systematic trend in transverse motions and "double waves" in longitude in the radial velocities and transverse velocities in any arbitrary plane; all the terms being proportional to the distance. The results are applied to a galaxy possessing a plane of symmetry with zero systematic motion perpendicular to it. It is shown, in agreement with Pilowski, that the effects of galactic rotation and galactic expansion are intermingled; the effect of galactic expansion, superposed on galactic rotation, is *in general* to rotate the directions of zero residual radial velocity away from the direction to the centre of the galaxy. The maximum amount of information that can be obtained from radial velocities and transverse proper motions as a function of longitude is discussed. [See Abstract 1164 (1932).] AUTHOR.

3345. Formation of Galaxies, Stars and Planets. T. Gustafson and H. Nordström. *Zeits. f. Astrophysik,* **10.** ***pp.*** **228–236,** ***June*** 6, 1935. *In English.*—A criticism is given on a paper by Strömberg [see Abstract 4907 (1934)] in which he advances a hydrodynamic theory for the development of the stellar system from a gaseous nebula in order to explain the characteristic features of the motions of the stars. It is shown that the reasoning by means of which his fundamental equations are derived, cannot be maintained, owing to an erroneous application of Hamilton's principle. **G. Strömberg** replies (*ibid.* pp. **234–236**). AUTHORS.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3346. Effect of a Variation of Mass on a Planetary Orbit. D. Graffi. *Accad., Lincei, Atti.,* 21. ***pp.*** 438–443, *March* 17, 1935.—Using the equations of motion (established by Levi-Civita) of a planet whose mass is increasing due to a fall of particles, the author establishes a formula for the variation of the eccentricity of a planetary orbit due to this increase in mass. He shows that a comparatively small variation in mass can account for an appreciable variation in the eccentricity of the orbit. A. J. McC.

See also Abstract **3321.**

NEBULÆ.

3347. Photographic Determination of Total Magnitudes of Extra-Galactic Nebulæ. Part I. P. C. Keenan. *Astrophys. J.* 82. *pp.* 62–74, *July*, 1935.—A description is given of the method in use at the Yerkes Observatory for measuring the total magnitudes of nebulæ by comparisons of extra-focal images. All comparisons are made directly with stars of the North Polar Sequence. After corrections for differential extinction and for size of image have been applied, the probable errors of the mean magnitude are of the order of 0·06 mag. Irregularity in the shapes of the images is one of the most serious sources of error. A catalogue of the brighter nebulæ discovered on the survey plates is included. AUTHOR.

PLANETS.

3348. Number and Effective Mass of Asteroids. B. de Jekhowsky. *Comptes Rendus*, 200. *pp.* 2061–2063, *June* 17, 1935.—The radius of each asteroid is calculated by taking its albedo to be equal to the average of those of Mars and Mercury. The radius is a function of the mean distance from the sun and the stellar magnitude of the asteroid. By plotting radius against number of asteroids it is concluded that all those with radius $>$ 60 km. are now known and that the maximum number of discoveries to-day is of asteroids with radius $<$ 30 km. The total number of asteroids is found to be 2334 and the total mass, assuming that all asteroids have equal mean density, is 6·4 times greater than the mass of Ceres. G. C. McV.

3349. Eclipses of Jupiter's Satellites. F. Link. *Comptes Rendus*, 200. *pp.* 2063–2065, *June* 17, 1935.—The light-curves of the first three satellites of Jupiter obtained by Eropkin in 1928 [see Abstract 367 (1932)] show a fairly flat secondary maximum. Reduction of these curves leads to the conclusion that this maximum occurs as if the planet were surrounded by an absorbing layer, analogous to the dark ring surrounding Saturn, whose upper level is at a height equal to one-fifth of the planet's radius above its surface. The maximum density in the layer occurs at a height of one-tenth radius. G. C. McV.

See also Abstracts 3321, 3345, 3346, 3368.

STARS.

3350. Absolute Magnitude of Be Stars. H. Mineur. *Comptes Rendus*, 200. *pp.* 2145–2147, *June* 24, 1935.—Gerasimovič classed the Be stars, *i.e.*, those stars whose spectra show the H lines in emission, amongst the super-giants but they were considered on the contrary by McLeod [see Abstract 1899 (1934)] to be giants of a little less than the average brightness. The author calculates the mean absolute magnitude of Be stars from the data concerning the radial velocities and proper motions of these stars contained in the catalogue of Merril and Burwell [see Abstract 4409 (1933)]. It is found that the Be stars are ordinary giants, having the same absolute magnitude as the ordinary B stars and that the emission arises from the large extension of their atmospheres. J. E. K.

3351. Star-Stream Theory. P. Wellmann. *Zeits. f. Astrophysik*, 10. *pp.* 188–198, *June* 6, 1935.—The theory of star-streaming proposed by Ogrodnikoff [see Abstract 3198 (1932)] is modified by the assumption that the relation between stream-velocity and external force varies with the time. The corrections to the original theory are of the right order of magnitude. G. C. McV.

3352. C, N and Si in the Spectrum of P Cygni. C. S. Beals. *Roy. Astron. Soc., M.N.* 95. *pp.* 580–585, *May*, 1935.—The identifications of the ions CII, CIII, NII, NIII, Si III and Si IV in the spectrum of this star are considered to be clear. With regard to Si II, only the lines λ 6346·61 and λ 6370·95 are taken as well-authenticated. The intensities and velocities of these lines are given for both emission and absorption, the temperature of the star being taken as 30,000° C. The value of the emission/absorption ratio decreases with ionisation potential as do the velocities of approach. The star is therefore believed to be surrounded by a stratified envelope, the stratification being due to absorption of ultra-violet light during photoelectric ionisation. The atoms of highest ionisation potential occupy the strata nearest the star. Since the velocities are found to be greatest for lowest ionisation potential, it follows that the atoms (in the range of ionisation considered) are accelerated outwards from the star. G. C. McV.

3353. Relative Multiplet Strengths in *LS* Coupling. L. Goldberg. *Astrophys. J.* 82. *pp.* 1–25, *July*, 1935.—The relative strengths of different multiplets in *LS* coupling have been calculated and tabulated for sixty-five transition arrays of astrophysical interest. In arrays where the jumping electron belongs to a shell of three or more equivalent electrons, the method of Condon and Ufford was employed; all other cases were dealt with by the extension of Kronig's formulæ to relative multiplet strengths, according to the methods outlined by Shortley. A description of the Condon–Ufford method is given, together with an illustration of its application to the transition array p^3-p^2s. It is shown, also, that in applying this method, it is necessary to write down the zero-order states of only one configuration, that involving the smallest number of terms. AUTHOR.

3354. External Radii of the Generalised Standard Model. N. Fairclough. *Roy. Astron. Soc., M.N.* 95. *pp.* 585–600, *May*, 1935.—The stellar models dealt with are those with perfect gas envelopes and cores of degenerate gas. The fit of the envelope on to the core requires the numerical solution of certain equations which involve Emden functions for $n = 3$ and $n = 3/2$. These numerical solutions are now tabulated. The results permit the construction of a diagram in which values of the external radius are plotted against values of $(1 - \beta)$, where β involves the luminosity, for constant mass. G. C. McV.

3355. Precision of Eddington's Mass-Luminosity Relation. G. Durand. *Comptes Rendus*, 200. *pp.* 1915–1918, *June* 3, 1935.—The constant C_1 in the mass-luminosity law: $L = C_1 M^{\frac{7}{5}} (1 - \beta)^{\frac{3}{2}} \mu^{\frac{4}{5}} T_e^{\frac{4}{5}}$, was determined by Eddington from the data provided by Capella alone. This constant is now found from the data provided by 20 stars in binary systems for which the individual masses are known and whose parallax probable errors are less than 10 %. The resulting correction to Eddington's value is approximately 1 %. The author discusses the other constants involved in the mass-luminosity relation and concludes that Eddington's original values for these constants give the most accurate results. G. C. McV.

3356. Distorted Outer Layers of Stars. S. Takeda. *Kyoto Coll. Sci., Mem.* 17. *pp.* 197–217, *July*, 1934.—A stellar model consisting entirely of degenerate gas has a tidally affected or uniformly rotating nucleus whose boundary is ellipsoidal. The outer layers are in equilibrium under the gravitational attraction of the nucleus alone. The configurations of the outer layers are determined, the problem being treated similarly to that of Roche's model. The theory is applied to binary systems. (See also Abstract 4404 (1933).] G. C. McV.

3357. Deductions from the Theory of Simple Galactic Rotation. J. M. Mohr. *Bull. Astronomique*, 9. 1. *pp.* 1–39, 1934.—Assuming that the galactic rotation has only one centre, in the position found by Shapley, that the sun's speed round that centre is 300 km./sec., and that the speed of the stars in our neighbourhood (based on 1160 giant stars used in this work) is 289·13 km./sec. in the direction of galactic coordinates $l = 56°·86$, $b = 0°$, it is shown that differences exist in the movements of different classes of stars. The mean eccentricities and inclinations of the orbits of K and M giants and supergiants are high (0·14 and ± 5°), but those of O to B and some A stars are very small (0·06 and ± 2°). Those of dwarf stars F to M, and still more those of rapidly-moving stars and others with special characteristics, are also high. It seems probable that stellar diameter plays a part here, which suggests a resistance in interstellar space. The discussion also shows that the sun's orbit has an eccentricity of 0·08, that its present distance from the centre is 10,000 parsecs., that it is now approaching perigalacticum, and will reach apogalacticum, in about 100 million years. M. A. E.

3358. Density Distribution of Stars in High Galactic Latitude. P. J. van Rhijn and A. Schwassmann. *Zeits. f. Astrophysik*, 10. *pp.* 161–187, *June* 6, 1935.—The regions considered are in galactic latitude + 50°. The distribution according to apparent magnitude (down to $m = +13$) shows a great increase in the percentage frequency of G-type stars (23 % to 59 %) with decreasing magnitude whilst the A, B and M stars decrease to 1 % or less. The density (actual number of stars per cubic parsec) in each spectral class is also computed and tables of the densities for increasing distance are given. The densities for dwarfs and giants are given separately and the corresponding densities found by Oort are also tabulated for comparison. The density of B stars is found to fall more rapidly with increasing distance than is the case for any other spectral class. For distances greater than 300 parsecs the new densities for G stars are greater than, whilst for K stars they are less than, those found by Oort. The densities relative to distance from the galactic plane are also computed. G. C. McV.

3359. Initial Radii of Novæ. S. Gaposchkin. *Harvard Coll. Obs., Bull.* 899. *pp.* 5–9, *May* 1, 1935.—The author expresses the proportional increase in luminosity L of Nova Herculis before maximum by $160{,}000 = R^2\,J \times \text{Const}$, where R is the radius and J the surface brightness for the mean wave-length observed, attributing the increase to expansion. He gives tables for 7 Novæ which afford accurate data before maximum, and for 20 others which afford only photometric data. Of the seven Novæ three have initial dia. $< 0·5\ \odot$, three from $1·5$ to $2\ \odot$, and one (N Pyx·1902) $190\ \odot$. Novæ with rapid and large range of brightness are initially dwarfish stars; those which are initially giant stars increase slowly and never have as large a range as the dwarf Novæ. All represent a more general case of variability than the Cepheid—long-period variables. Normal Novæ are of the solar diameter and have initial luminosity of + 3 to + 5 and a maximum of − 7 and − 5. A. S. D. M.

3360. Parallax of Nova Herculis 1934 Deduced from the Intensity of the Interstellar K Line. E. G. Williams. *Roy. Astron. Soc., M.N.* 95. *pp.* 573–580, *May,* 1935.—The intensity of the interstellar *K* line has been measured on 24 plates. It is found that when the line is blended with the strong Nova *K* line the measured intensity is too small. A mean intensity of 11·7 in 0·1 wave-number units is derived from fifteen plates on which the line is clear of stellar absorption. The material suggests that the ratio of *K* to *H* is abnormally large. *H* has been measured on eight plates, but on one good plate it was almost invisible. Radial velocity measures made by Stratton confirm the detached character of both *H* and *K*, as the mean value differs by only 2·2 km./sec. from the component of the solar motion. A distance of 370 parsecs is derived by comparing the strength of interstellar *K* in the Nova with its intensity in a number of early-type stars whose distances are given by the spectroscopic parallax method. This distance corresponds to an absolute magnitude of − 6·5 at maximum, whilst the mean pre-outburst magnitude is about + 6·7. AUTHOR.

3361. Spectrum of Nova Herculis. W. Grotrian and W. Rambauske. *Zeits. f. Astrophysik,* 10. *pp.* 209–223, *June* 6, 1935.—Two spectra of this Nova were taken on January 3, 1935, with the 80 cm. refractor and single-prism spectrograph at Potsdam, in the region λ 6300 to 3834. The lines have been measured and identified, and the shift to violet of the absorption lines of different elements has been estimated. M. A. E.

3362. Orbit of Binary Systems of the Type 61 Cygni. F. Zagar. *Accad. Lincei, Atti,* 21. *pp.* 353–357, *March* 3, 1935.—The well-known method of Kowalski for the calculation of the orbit of a visual binary system does not make use of the law of areas and this leads to difficulties in certain cases. The author proposes an improvement in the method by taking account of the law of areas, which is particularly applicable to double systems of the type 61 Cygni, that is, of systems formed by two stars with a long period of revolution. He then shows how the method can be extended to be applicable to other types. A. J. McC.

3363. Velocities of Axial Rotation of the Components of Spectroscopic Binaries. E. A. Kreiken. *Zeits. f. Astrophysik,* 10. *pp.* 199–208, *June* 6, 1935. *In English.*—The velocity of axial rotation of the components of spectroscopic binaries is compared with the corresponding velocity of the single stars. It appears, that with the spectroscopic binaries $\overline{V_0/V_s}$ is systematically smaller than with the single stars (V_0 = observed velocity of axial rotation; V_s = the mean velocity of axial rotation of the stars of a given spectral type). With the spectroscopic binaries $\overline{V_0/V_s}$ systematically decreases towards the later types. It seems rational to ascribe the defect in the rotational velocities of the components of the spectroscopic binaries to the influence of the gravitational pull of tides on tides. The influence of this gravitational pull is not sufficient to keep the period of axial rotation equal to the period of orbital revolution. AUTHOR.

3364. Light Maxima of SS Cygni. G. R. Miczaika. *Zeits. f. Astrophysik,* 10. *pp.* 224–227, *June* 6, 1935.—Not many variable stars of this class are known, and no other but this has been observed continuously for several decades. Its light-curve when near maximum (over 11m.3) is here discussed and compared with available data for

7 others; and it appears that the brighter the star the flatter the curve at maximum. M. A. E.

3365. Heterochromatic Studies of the Companions of Sirius, of *o* Ceti, and of o_2 Eridani. C. Hetzler. *Astrophys. J.* 82. *pp.* 75–86, *July,* 1935.—A simple device is described whereby the companion of Sirius was separated at the photographic focus of the Thaw refractor. Methods of separation in the red and ultra-violet are sketched. Magnitudes for a number of Sirius field stars are derived in terms of the B9 field star, BD $-$ 17° 1611, of magnitude 6·76. The resulting photographic and red magnitudes of Sirius B, of probable error less than $0^{\mathrm{M}}.1$, are $7^{\mathrm{M}}.95$ and $8^{\mathrm{M}}.44$, respectively, as compared with Wendell's visual value of $8^{\mathrm{M}}.44$, confirmed by Kuiper at Leiden and at the Lick Observatory, and with Vyssotsky's photo-visual value of $7^{\mathrm{M}}.1$. The corresponding magnitude of Sirius A is $-1^{\mathrm{M}}.22$, without appreciable colour index. Photographic positions of components A and B of Sirius relative to field stars are given at intervals since 1932; resulting values of ρ and θ are compared with calculated positions and with recent visual observations. No sign of a third component is visible. Photographic and ultra-violet observations of *o* Ceti B are described. The photographic magnitude in terms of that assumed for the distant companion to *o* Ceti is 11·2. Several measurements of ρ and θ are tabulated. As a comparison, the red and ultra-violet indices of o_2 Eridani B are found to agree with those of Sirius B. AUTHOR.

See also Abstracts 3341, 3344, 3345, 3457.

SUN.

3366. Turbidity Coefficient and Sky Radiation. H. Prull. *Gerlands Beitr. z. Geophys.* 44. 3. *pp.* 287–299, 1935.—A formula for sky radiation given by Berlage is applied to a turbid atmosphere by introducing the turbidity coefficient (β) given by Angström. It is shown that the sky radiation (H_λ) has a maximum depending on the value of β, and as β increases the maximum shifts to longer wave-lengths. The variation of the ratio S_λ/H_λ, where S_λ is the solar radiation, in relation to changes of β and different zenithal distances of the sun is tabulated. In the ultra-violet and blue-violet $H_\lambda > S_\lambda$ as shown by Hoelper. The variation of the total sky radiation for the range 0·3 to 0·7μ is shown as a function of zenithal distance for different values of β. It is shown that one-third of the solar radiation lost by diffusion comes to the earth as sky radiation for a clear sky, but in a very turbid atmosphere only one-fifth arrives. R. S. R.

***3367. Universal Actinograph. P. Dubois.** *Naturwiss.* 23. *pp.* 450–453, *June* 28, 1935.—The total intensity of solar radiation has been measured at Danzig for several years but the hourly and daily summations from the curves involved laborious work. The new apparatus devised is shown in two detailed diagrams. It measures the total solar radiation intensity simultaneously on horizontal and normal surfaces and filters are also used independently for distribution of the intensity. The apparatus integrates the results automatically. The instrument can be set up in any latitude and climate. R. S. R.

3368. Positions and Semidiameters of the Moon and Sun from Solar Eclipse Observations. S. Ishii, K. Kubokawa and M. Torao. *Japanese J. of Astron. and Geophys.* 12. 2. *pp.* 121–130, 1935.

See also Abstracts 3377, 3395, 3441, 3688.

GEOPHYSICS.

GEODESY.

3369. Effects of the Ellipticity of the Earth on the Reductions of Gravity Measurements. S. Ballarin. *Com. Geod. e Geofis., Boll.* **5.** *pp.* **81–84,** *April,* **1935.**—Corrections made by taking account of the ellipticity of the earth are always negligible in the formulæ for the reduction of gravity on the assumption of a sphere. W. A. R.

3370. Figure of the Earth from Gravity Observations and the Precision Obtainable. J. de G. Hunter. *Roy. Soc., Phil. Trans.* **234***A*. *pp.* **377–431,** *July* **15, 1935.**—The form of the sea-level surface of the earth—the real geoid—can easily be obtained from the form of a compensated geoid. The law of external potential of a rotating, gravitational solid, whose boundary is an equipotential and differs slightly from a spheroid, is deduced. From this the departures of a compensated geoid from a reference spheroid, suitably chosen, is expressed in terms of the departures of compensated gravity from the values given by a standard formula representing the gravity of this reference spheroid, now considered as a solid rotating body. The deduction has been made without assunption as to the form of the potential. The distribution of gravity stations, and their number designed to give adequate precision in the form of the compensated geoid is also considered. W. A. R.

GEOPHYSICS, APPLIED.

3371. Development of the Process of Electric Coring. A. Belluigi. *Com. Geod. e Geofis. Boll.* **5.** *pp.* **128–134,** *April,* **1935.**—The advantages of electric coring [see Abstract 4926 (1934)] have been demonstrated by an increasing use in the petroleum fields of Russia and elsewhere. Examination by strata, fossils and so forth, does in many cases break down where the bore shows only a muddy substance of uniform colour, also other uncertainties due to the specific gravity of the oil or the presence of water may make the results of little value. Diagrams are given to show the methods used: thermocouples and resistance thermometers measure the temperature, and potential measurements give the resistance at any one place and along the bore, thus indicating the nature of the strata. H. M. B.

METEOROLOGY.

3372. Composition of the Air of the Stratosphere. A. Lepape and G. Colange. *Comptes Rendus,* **200.** *pp.* **1871–1873,** *May* **27, 1935.**—The authors after referring to observations by other investigators in which the composition of the air in the stratosphere was found to be the same as at the surface of the earth, discuss the results found from a series of samples taken by them between 1926 and 1930. The percentages of the gases are given in tabular form. These percentages are nearly constant at all altitudes and similar to those at the earth's surface. From this and other factors the authors conclude that the atmosphere must present an almost uniform composition throughout its whole thickness. He is shown to be present though in small quantities. [See following Abstract.] A. E. M. G.

3373. Water Vapour and Carbon Dioxide in the Stratosphere. A. Lepape and G. Colange. *Comptes Rendus*, 200. *pp.* 2108–2110, *June* 17, 1935.—This is a continuation of previous work [see preceding Abstract]. The content of water vapour found corresponds to pressures of from 0·1 to 0·4 mm. Hg. This is many times the saturation pressure at the stratosphere temperature. The mean value of the CO_2 content from 9 to 16·2 km. is 0·06 %, double that at the surface of the earth. Several causes for this high proportion of CO_2 are suggested. This investigation helps to confirm relations between the upper and lower layers of the atmosphere previously suggested. Ozone, CO_2 and water vapour exist both at the surface in proportions varying with the meteorological conditions, and also in the stratosphere in unexpected quantities and also variable. A. E. M. G.

3374. Estimation of Atmospheric Ozone by Means of Fluorescein. W. Heller. *Comptes Rendus*, 200. *pp.* 1936–1938, *June* 3, 1935.—An account is given of investigations upon the possibility of estimating ozone by means of fluorescein. The gas is passed through a column containing fluorescein solution and the diminution of fluorescence after a certain time is measured, the results being compared with observations upon standard fluorescein solutions. The possible application of the method to the estimation of atmospheric ozone is discussed. Owing to the intervention of a disturbing reaction (probably decomposition of the ozone on the walls of the apparatus) it is found necessary with the form of apparatus used to stop the reaction at an ozone pressure about ten times greater than that in the lower layers of the atmosphere. However, the admixture of O_2, N_2 or oxides of N has very little effect upon the results, so that the method is considered to be superior to the iodometric method. L. A. W.

3375. Heat Radiation from the Clear Atmosphere at Night. P. K. Raman. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 815–821, *May*, 1935.—Two expressions have been given for the downward radiation incident on $1 cm.^2$ from the atmosphere, one by Brunt $S = \sigma T^4 (a + b \sqrt{e})$ and the other by Ångstrom, $S/\sigma T^4 = A - B \cdot 10^{-\gamma e}$ where a, b, A, B and γ are constants. These are first considered separately and the values of the constants in both expressions tabulated for various stations. The author then turns to examine the relation between the two formulæ. A value of $S/\sigma T^4$ below 0·5 is to be expected when the air is very dry. A table gives a number of values of $S/\sigma T^4$ observed when the aqueous vapour pressure was exceptionally small. The only observations showing a value less than 0·5 are those got by Ångstrom in balloons at great heights. More observations under exceptionally dry conditions are required before definite conclusions can be reached. A. E. M. G.

3376. Ångstrom's Formula for Atmospheric Radiation. Nocturnal Cooling of Air-Layers near the Ground. K. R. Ramanathan and L. A. Ramdas. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 822–829, *May*, 1935.—The wave-lengths of the atmospheric radiation are divided into three groups and an expression for S_T^W, the radiation from an isothermal atmosphere, is found in the form $S_T^W = S_2 + S_3 - S_2 \exp. (- \frac{3}{2} k_2 w)$, the effect of the group S_1 being negligible. This is similar to Ångstrom's empirical formula for atmospheric radiation $S/\sigma T^4 = A - B \cdot 10^{-\gamma e}$ where

A, B and γ are constants. From the absorption properties of water vapour the constants in the first equation are found. On the basis of Hettner's values, $S_2^W/\sigma T^4 = 0\cdot 86 - 0\cdot 32 \times 10^{-6W}$. This gives a high value for the index of 10 and a closer approximation to the empirical value is found from Weber and Randall's measurements. It is then shown that the temperature of the atmospheric layer responsible for S_2 which reaches to great heights, is not that close to the place of observation. Furthermore, the effective temperature is lower the drier the atmosphere. Dealing with nocturnal cooling on calm clear nights the authors point out that the minimum temperature is observed at a distance of half to one foot above the ground. Reasons for this temperature distribution are given. Investigations for a fuller elucidation of the various factors involved have been commenced. A. E. M. G.

3377. Temperature of Space. K. Wegener. *Gerlands Beitr. z. Geophys.* 44. 3. *pp.* 346–349, 1935.—Having indicated the method by which radiation measurements permit of calculating the effective radiation temperature of a body, the author finds the temperature of space as − 40° C. assuming the mean temperature of the earth as 15° C. Observation shows that temperature falls to − 70° C. in certain regions. To account for this it is suggested that radiation from the earth in different directions of space may be different. As the radiation temperature in surrounding space is probably different, an experimental investigation of the same is suggested and the method to be employed indicated. A. E. M. G.

3378. Wind Data for Wind Mills. V. D. Iyer. *Indian Meteorolog. Dept., Sci. Notes,* 6. 63. *pp.* 57–84, 1935.—Monthly normals of wind velocity for 205 observatories in India and a few stations in the neighbouring countries are given and the distribution of wind velocities in the different seasons is illustrated by charts. Curves of the diurnal variation of wind velocity at 22 stations for the four seasons are given. Tables giving the frequencies of occurrence of winds of different speed ranges, and of days with different total duration of wind-speeds exceeding 6 miles per hour which is considered the minimum for working a wind mill for agricultural purposes, have also been prepared for fifteen stations. The data presented are briefly discussed. AUTHOR.

3379. Equilibrium of Surface Air Layers. P. T. Smoliakow. *Gerlands Beitr. z. Geophys.* 44. 3. *pp.* 321–336, 1935.—The conditions of equilibrium of surface layers of air are investigated when superadiabatic temperature gradients exist. These conditions can be observed on hot summer days in an unstable continental air mass. It is shown that the well-known conditions of equilibrium cannot explain exactly the possibility of the existence of these temperature gradients and a more accurate formula is derived mathematically. Finally, the question is considered from the standpoint of turbulence in the atmosphere. R. S. R.

3380. Lunar Tide in the Earth's Atmosphere. S. Chapman. *Roy. Soc., Proc.* 151*A*. *pp.* 105–117, *Aug.* 1, 1935.—All the known reliable determinations of the lunar atmospheric tide are collected and illustrated by diagrams, showing (1) the geographical distribution of the tide, (2) the dependence of its amplitude and phase upon the latitude, (3) the amplitude and phase for each calendar month for certain stations, and (4) the dependence of the annual variation of the tide upon the latitude. [See Abstracts 2473 and 2927 (1935).] AUTHOR.

3381. Transparency of Air Between 1100 and 1300 Å. T. Lyman. *Phys. Rev.* 48. *pp.* 149–151, *July* 15, 1935.—It has long been predicted that the air possesses considerable transparency for light in the region between 1100 and 1300 Å. This paper deals with a very simple method of demonstrating this transparency by the use of a thermoluminescent screen. Secondary products of the investigation are (i) a study of the selective sensitivity of the screen just mentioned; (ii) a determination of the nature of the so-called *Entladungsstrahlen*; and (iii) the description of a simple method of testing the transparency of LiF crystals. AUTHOR.

3382. Filter Photographs of Red Auroræ. L. Harang. *Gerlands Beitr. z. Geophys.* 44. 3. *pp.* 229–235, 1935.—Three photographs of the same aurora are taken simultaneously with identical cameras but with three different filters, one showing wave-lengths in the red longer than 6100 Å, a second longer than 6400 Å and a third in the green. This shows that near the lower edge of the aurora there is a red light due to a line 6320 Å. The transparent regions of the filters are shown by spectrometer photographs. The filter photographs of the auroræ are analysed by a photo-micrometer. H. M. B.

3383. Red Lines of Oxygen in the Night-Sky Spectrum. J. Cabannes. *Comptes Rendus,* 200. *pp.* 1905–1908, *June* 3, 1935.—The presence of the O red triplet $^1S_0 \rightarrow {}^3P_{0,1,2}$ in the night-sky spectrum has not hitherto been clearly established. On a spectrogram obtained in an 8½ hr. exposure the first component is remarkably strong and is measured as λ 6301·4 ± 0·6; the second component is measured less precisely as λ 6361·7; the third is not detectable. Ten previously observed bands are measured. The strongest has two components. From photometric results it is concluded that two-thirds of the oxygen in the luminescent layer at 200–300 km. in the upper atmosphere is atomic, and that there are three times as many unexcited N_2 molecules as unexcited O atoms. Small numbers of these are excited electronically to metastable states $\text{A}\,^3\Sigma$ and $^1S_0$, the upper states for the N_2 Vegard-Kaplan bands [see Abstract 2482 (1935)] and the O line λ 5577. Intensity variations of λ 6301 are due to the presence of low-energy electrons which excite O to $^1D_2$ only. W. J.

***3384. Absolute Water-Vapour Content of Gases by Psychrometric and Hygroscopic Methods. F. Lieneweg.** *Wiss. Veröff. a.d. Siemens-Werken,* 14. 2. *pp.* 20–31, 1935.—After a short critical survey of the most useful experimental methods, approximate formulæ are deduced for the dependence of dew-point upon the temperatures of wet- and dry-bulb thermometers. Application of these formulæ make possible a continuous indication of absolute humidity by the use of simple electrical bridge arrangements. Similar considerations are advanced for the hair hygroscope and a description is given of a suitable electrical device for the continuous direct indication of absolute humidities in connection with this instrument. L. A. W.

***3385. Rain Gauge for Minimum Falls. J. Barnóthy and B. Béll.** *Zeits. f. Instrumentenk.* 55. *pp.* 264–265, *June,* 1935.—A metal cylinder is covered with a layer of filter-paper held in place by a spiral of wire. The inside of the cylinder is raised in potential and joined to a relay; the glowing terminal of the relay is joined through the resistance to the wrapping wire. When the paper is dry the wire is insulated from the metal, but when a drop of rain falls on the paper, the resistance is reduced and the relay shows either by an electric current or by reflection of light the time and duration of the shower. By heating the metal cylinder, it is possible to dry the paper quickly after a shower, and also to prevent deposition due to mist or fog. H. M. B.

***3386. Apparatus for Measuring the Drying Power of the Atmosphere. J. R. Baker.** *Journ. Sci. Instruments,* 12. *pp.* 214–216, *July,* 1935.—An apparatus is described which gives direct readings of saturation deficiency, without calculation. A nomogram is also described which gives the saturation deficiency without calculation, from data of temperature and relative humidity. AUTHOR.

See also Abstracts 3366, 3367, 3436, 3507, 3688.

SEISMOLOGY.

3387. Focal Depth of Earthquakes. H. P. Berlage, Jr. *Gerlands Beitr. z. Geophys.* 44. 4. *pp.* 353–357, 1935.—The author refers to the difficulty that arises when the nature of the first P wave does not permit the exact identification of the onset of the *p*P wave. With deep foci the latter is a prominent feature especially with vertical seismograms. The *p*P–P difference is exceptionally useful to get the focal depth. It is explained why a contracted form of the author's equation leads to an exceptionally good approximation. A table is given of focal depths for nine earthquakes obtained by the author's exact method and these values are compared with those obtained by others. R. S. R.

3388. Times of Transmission of Earthquake Waves. H. Jeffries and K. E. Bullen. *Union Géodésique et Géophysique Internationale, Publ. Fasc.* 11. [106 *pp.*], 1935.—The times of transmission of earthquake waves as obtained from phases other than P and S are now determined. Various methods are critically discussed, and the paper is accompanied by full tables. W. A. R.

3389. Earthquakes Recorded in Artesian Wells. R. M. Leggette and G. H. Taylor. *Seismological Soc. of America, Bull.* 25. *pp.* 169–175, *April,* 1935.—During the earthquakes of March 12 and April 14, 1934, a recording pressure gauge was in operation on an artesian well in Ogden Valley, Utah. The fluctuation of pressure recorded during these earthquakes was about 5·5 and 3·8 lbs. per sq. in., respectively. This instrument is so constructed that very little water moves into or out of the well when changes of hydrostatic pressure take place, and thus the rapidly oscillating changes in hydrostatic pressure that occur during earthquakes are recorded. This suggests a quantitative method of recording earthquakes that may yield data not given by present methods. AUTHORS.

***3390. Reduction of Seismograms Obtained in Shaking-Table Experiments. K. Dyk.** *Seismological Soc. of America, Bull.* 25. *pp.* 119–137, *April,* 1935.—The apparatus and seismograms obtained are fully described and figured. It is shown that integration of such a seismogram will give the form of the table motion producing it, but that the error in the actual amplitude of the computed table motion is likely to be in excess of the actual displacement. This is due mainly to uncertainty in the position of the time axis on the seismogram, and might be remedied by using two seismographs with different constants to record the same motion. C. A. S.

✱3391. Zero-Length-Spring Seismograph. L. J. B. Lacoste. *Seismological Soc. of America, Bull.* 25. *pp.* 176–179, *April*, 1935.—It has been found that for the zero-length-spring seismograph recently described [see Abstract 3224 (1934)] the length of the arm need not equal the distance from the pivot to the point of attachment of the spring. The proof of the infinite period is given for the more general case, and the effect on the period of slight deviations from the conditions for infinite period is shown. Author.

See also Abstract 3333.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3392. Small-Ion Production in the Atmosphere. G. R. Wait. *Terr. Mag.* 40. *pp.* 209–214, *June*, 1935.—The rate of small-ion production and the combination coefficients have been calculated from observations at Kew and Washington, D.C. by equations derived theoretically by Whipple, but the production rate is not in good agreement with that obtained by a thin-walled ionisation chamber. The combination coefficient between small and large ions obtained by the latter method yields a value much in excess of that derived from Whipple's formula and somewhat higher than that deduced theoretically by Harper. The coefficient so obtained shows a diurnal variation similar to that of the small-ion content and is even more closely related to the diurnal variation of the reciprocal of the large-ion numbers. Nolan's square-root law does not agree with results and a new relationship between formation and destruction of small-ions is found. Further experimental tests of this formula are required. H. M. B.

3393. Electrical Discharges from Drops in Air. J. Zeleny. *Frank. Inst., J.* 219. *pp.* 659–675, *June*, 1935.—A study of previous work on discharges from charged attached drops and from uncharged drops falling in electric fields shows that the surface electric intensities at these drops, when the discharges begin, satisfy the theoretical relations for surface instability. Glow discharges, if initially present, are conditioned by the surface deformation arising from instability. Experiments are described that indicate that the highly charged droplets ejected by an alcohol surface may have mobilities not much below those of normal air ions while such droplets coming from a water surface may have mobilities even greater than those of air ions. Calculations, by Stokes' law, show such large mobilities for both kinds of drops to be possible. Further experiments show that under certain conditions the whole discharge current from an alcohol drop is carried solely by droplets of the liquid, resulting from surface instability, and under more restricted conditions the same may be true for a water drop. Author.

3394. Magnetisation of the Earth under the Oceans. A. Nippoldt. *Terr. Mag.* 40. *pp.* 129–138, *June*, 1935. *In German.*—Earlier the author described a rapid method based on the computation of Bauer's "local magnetic constant," $G = H\sqrt{1 + (\tan^2 I)/4}$ for a number of points distributed over the earth's surface and investigated the law of distribution using the results from various observatories. This is extended now to ocean areas. The method of computation is described and the results shown for 1922 in a map giving lines of equal inhomogeneous magnetisation at intervals of 1 milligauss or 100 γ. The distribution of inhomogeneous magnetisation is systematic over the oceans and has its seat principally at depths having little to do with the surface distribution of land and water. Polar movement is considered to have little weight on changes in the distribution. In connection with the question of constancy of magnetisation of masses at great depths in the earth's crust, comparison with several recent studies of anomalies are made. R. S. R.

3395. Secular Change in Magnetic Solar-Diurnal Variations. A. G. McNish. *Terr. Mag.* 40. *pp.* 151–158, *June*, 1935.—A complete change of the character of the solar-diurnal variations of vertical magnetic intensity observed at the Huancayo Magnetic Observatory during the past sunspot-cycle is described. Detailed features of this change are discussed and found to be qualitatively in agreement with expected changes. The large magnitude of the changes indicates that the solar-diurnal variation is a complex function of the earth's general field such as is called for by the atmospheric-dynamo theory of Balfour Stewart. Statistical considerations lead to the conclusion that the reality of the change is established to an extraordinarily high degree of probability. AUTHOR.

3396. Determinations of the Magnetic Declination at Sea on a Motor-Boat. G. S. Ljungdahl. *Terr. Mag.* 40. *pp.* 139–146, *June* 1, 1935.—An account is given of the method used to determine the magnetic declination at sea on an ordinary motor-boat. The reliability of the results is ascertained by repeat-measurements. Dynamic deviations of the liquid-compass are demonstrated. Results in a rough sea determined by observations on a single heading may be less trustworthy than a mean obtained on various headings. AUTHOR.

RADIOACTIVITY.

3397. Half-Lives of K, Rb, Nd and Sm. A. Ruark and K. H. Fussler. *Phys. Rev.* 48. *pp.* 151–154, *July* 15, 1935.—The long apparent half-lives of K, Rb and Nd are in striking disagreement with theory. To relieve this discrepancy, at least in part, the suggestion has often been made that their activities are due to isotopes of small abundance, having half-lives small in comparison with the apparent ones. Using data on the relative abundance of the elements, it is shown that the half-life of the active fraction of K is greater than 10^7 years, and that the active fractions of Rb, Nd and Sm have half-lives greater than 10^8 years. It is pointed out that these activities may be caused by small radioactive fractions of well-known isotopes; RaD and stable Pb(210) constitute a similar case. Data are presented which show that it is possible for the active portions of Nd and Sm to be genetically connected. AUTHORS.

3398. Emanation Capacity and Characteristic Temperature of Ra-Containing Metals. O. Werner. *Naturwiss.* 23. *pp.* 456–459, *June* 28, 1935.—A new method for the activation of any metals and alloys with Ra and ThX is described. The observation is brought forward that the temperature coefficient of the emanation capacity is inversely proportional to the characteristic temperature of the metal concerned. Some conclusions following on the significance of the curves connecting emanation capacity and temperature are considered. J. J. S.

3399. Chemical Action Produced by α-Particles: Combination of Deuterium and Oxygen. S. C. Lind and C. H. Schiflett. *Am. Chem. Soc., J.* 57. *pp.* 1051–1052, *June*, 1935.—The rate at which deuterium combines with oxygen under the influence of the α-rays of radon is found to be about 25 to 30% slower than the corresponding rate of the combination of hydrogen and oxygen. AUTHORS.

3400. Fine Structure of α-Rays and Its Relation with γ-Rays. A. Ciccone. *N. Cimento,* 12. *pp.* 247–268, *April,* 1935.—A survey is given of recent discoveries and new theories regarding radioactivity and the structure of the nucleus, including also a review of (1) the relation between the γ-rays and the fine structure of the α-rays, (2) α-rays of long range, and (3) the γ-rays and the magnetic spectrum of the β-rays.
J. J. S.

3401. Specific Ionisation of Single α-Particles. G. Stetter and W. Jentschke. *Phys. Zeits.* 35. *pp.* 441–445, *June* 15, 1935.—Using a double ionisation chamber the specific ionisation of single α-particles from Po and from ThC was examined. Maximum ionisation occurs $4 \cdot 4 \pm 0 \cdot 3$ mm. from the end of the range in air at N.T.P. and for the last few cm. of path the ionisation of all α-particles is the same. Straggling therefore arises from unequal energy losses which occur at the commencement of the range and it is concluded that loss of energy by fast α-particles can occur by some process other than by ionisation.
F. C. C.

3402. Photographic Recording of H- and α-Particles. A. Jdanoff. *J. de Physique et le Radium,* 6. *pp.* 233–241, *June,* 1935.—Emulsions containing AgBr have been studied with a view to recording more successfully the tracks of α-particles and protons which pass through them. The effects of grain size and concentration are studied and an emulsion obtained in which simultaneous recording of protons and α-particles is possible. It has been possible with these emulsions to observe recoil protons due to α-particles and neutrons and stereoscopic photographs showing these are reproduced. J. E. R. C.

3403. Scattering of α-Particles from Polonium by O_2 and Ne. W. Riezler. *Ann. d. Physik,* **23.** 3. *pp.* 198–206, *June,* 1935.—Using the annular ring method of Rutherford and Chadwick, together with a point counter, an investigation is made of the scattering of α-particles from Po by O_2 and Ne in the region between 55° and 90°. With α-particles of range from 1·2 to 3·7 cm. Ne obeys the classical scattering law and gives from Gamow's theory a radius of the potential hole of $4{\cdot}6 \times 10^{-13}$ cm. With O_2, however, for α-particles of range somewhat above 3 cm. the scattering is below the classical, Gamow's theory giving a radius of $4{\cdot}5 \times 10^{-13}$ cm. F. C. C.

3404. Schematic Representation of Anomalous Scattering by Suitable Nuclear Fields. L. H. Horsley. *Phys. Rev.* **48.** *pp.* 1–6, *July* 1, 1935.—An attempt to represent Pose's data on the collision of α-particles and protons by a schematic nuclear model has led to results which are consistent with other information concerning the position of nuclear energy levels. The picture obtained seems also to apply to the results of Wenzel concerning the scattering of α-particles by other light elements. [See Abstracts 4489 and 4491 (1934).] AUTHOR.

3405. Theory of β-Decay. G. Beck. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 31–42, *Physical Society.*—The neutrino hypothesis and Fermi's theory are discussed and their limitations pointed out. An alternative hypothesis developed by the author is that the second particle is a positive or negative electron which is subsequently captured by the nucleus, in a manner not yet accounted for. It is shown that the theory accounts qualitatively for the main features of β-decay. W. E. P.

3406. β-Ray Disintegration. C. D. Ellis. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 43–59, *Physical Society.*—Disintegration by the emission of β-particles is considered in a manner analogous to that for α-particles, the upper limit of the β-spectrum corresponding to the energy of the α-particle. The energy levels and corresponding spins in the series ThC, ThC′, ThC″ and ThD are examined in detail in the light of Fermi's theory. Similar considerations are applied to the radium series. It is shown that the measured shape of the high energy end of the β-ray curves for ThC.C′ and ThC″Pb are in favour of a zero rest mass for the neutrino. In the final section of the paper the setting up of the level system and excitations of RaC′ is described. Certain discrepancies between the theoretical and experimental values of the internal conversion coefficients are pointed out. W. E. P.

3407. Stability of Nuclei. G. Gamow. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 60–66, *Physical Society.*—The conditions for nuclear stability relative to the spontaneous emission of particles are discussed. The stability of ${}^{9}_{4}$Be is explained if the nucleus is assumed to contain a negative proton; the existence of this particle is indicated by the occurrence of isotopic isobares such as RaD and the stable Pb atom of mass 210. The stability conditions for the emission of positive as well as negative electrons are considered with reference to the $\frac{n_1}{n_2}\Big/ n_1 + n_2$ diagram, where n_1 and n_2 are the numbers of neutrons and protons respectively. Such a diagram, showing all known isotopes, is plotted. Considerations of α- disintegration show that the radioactive elements lie in the parts of the diagram where they are to be expected on theoretical grounds. W. E. P.

3408. Natural β-Decay. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 66–71, *Physical Society.—Discussion* by **H. A. Bethe ; W. M. Elsasser ; E. Fermi ; H. O. W. Richardson ; K. Sitte.**

3409. β-Radiation of Actinium C″, Mesothorium 2, and Uranium X_1 and Its Derivatives. M. Lecoin. *Comptes Rendus,* 200. *pp.* 1931–1934, *June* 3, 1935.—Using a similar method [see Abstract 4440 (1933)] with an arrangement whereby measurement of the unfiltered radiation can also be made, the energy distribution of the β-radiation from AcC″, MsTh–2, and UX_1 and its derivatives as far as 2×10^6 eV has been determined. The average energies are respectively 4·7, 4·2 and $7{\cdot}35 \times 10^5$ eV, and the maximum energies of AcC″ and MsTh–2 1·56 and $1{\cdot}63 \times 10^6$ eV. The curve for UX_1 is complicated by the disintegration of that element into UX_2 and UZ ; but it perhaps indicates that the bifurcation ratio is 3 % instead of the accepted 0·3 %. C. A. S.

3410. Fermi Theory of β-Radioactivity. E. J. Konopinski and G. E. Uhlenbeck. *Phys. Rev.* 48. *pp.* 7–12, *July* 1, 1935.—A comparison of Fermi's formula [see Abstract 1547 (1934)] for the distribution in energy of the electrons and positrons emitted by radioactive bodies with the observed spectra seems to show that a basic factor in it, the statistical factor, is not asymmetric enough. Since about the same degree of asymmetry is common to the spectra of light and heavy nuclei and of positron and electron emitters, it cannot be ascribed to another factor in the Fermi formula, depending on the nuclear field. A weight factor is introduced to provide the required asymmetry by changing the form of the Fermi interaction energy. It is shown that two almost equivalent points of view can be employed in attacking this problem and that a certain uniqueness in the form of the interaction law can be obtained within the requirements laid down by Fermi. The modified distribution formula, which holds strictly only for light nuclei, is then shown to give a much more satisfactory agreement with the data than the original formula. AUTHORS.

3411. β-Decay Theory. R. L. Dolecek. *Phys. Rev.* 48. *pp.* 13–17, *July* 1, 1935.—A method is developed which allows one to calculate, according to the Fermi treatment, the energy distribution of the β-electrons for any assumptions on the angular momentum balance. The evaluation of the distribution functions show disagreement with the experimental data for heavy radioactive nuclei. The distribution curves support the criticism of the Fermi treatment given by Beck and Sitte. [See Abstract 2830 (1934).] AUTHOR.

3412. Experimental Method of Detecting the Neutrino. M. Wolfke. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A. pp.* 19–23, *Jan.–Feb.,* 1935. *In German.*—It is suggested that a strong source of RaE on a Pb base should be placed in an expansion chamber in such a way that the primary β-particles and softer γ-rays from the RaE are completely absorbed in the base. Assuming the rest mass of the neutrino to be zero the secondary β-particles which should be liberated by Compton encounters of the neutrinos with electrons in the Pb, should have a mean energy of $0 \cdot 82 \times 10^6$ eV. With a source of 100 milli-curies about 1 track would be expected for every 100 photographs if the cross-section of the neutrino for electrons is about $6 \cdot 6 \times 10^{-33}$ cm.^{2}. [See following Abstract.] F. C. C.

3413. Effective Cross-Section of the Neutrino. M. Wolfke. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A*. *pp.* 107–109, *March–April*, 1935. *In German.*—Considering the experiment of Chadwick and Lea [see Abstract 1093 (1934)] it is pointed out that the effect of fast secondary electrons liberated by the Compton interaction of the neutrinos and electrons has been neglected. Correction leads to an upper limit of effective cross-section of $6 \cdot 6 \times 10^{-33}$ cm.^{2} corresponding to a free path of $3 \cdot 9 \times 10^{11}$ cm. in air at S.T.P. as opposed to $1 \cdot 7 \times 10^{-28}$ cm.^{2} deduced by Chadwick and Lea. [See preceding Abstract.] F. C. C.

3414. Heat Evolution by γ-Radiation from Ra(B + C). I. Zlotowski. *J. de Physique et le Radium*, 6, *pp.* 242–252, *June*, 1935.—The following results are now given :—Heating effect of Ra in equilibrium with its decay products: $139 \cdot 6 \pm 0 \cdot 3$ cal./gm./hr.; energy of the γ-radiation of Ra(B + C): $9 \cdot 1 \pm 0 \cdot 15$ cal./gm./hr.; energy of the β-radiation of Ra(B + C): $> 6 \cdot 1$ cal./gm./hr. The coefficient of absorption in lead of the γ-radiation is also determined. From the results the author has calculated the absolute distribution of energy in the γ-radiation spectrum of Ra(B + C). Finally, using the internal absorption coefficients given by Ellis and Aston, the number and energy of the secondary electrons are calculated and agree with results obtained in other ways. [See also Abstract 4135 (1934).] J. E. R. C.

3415. γ-Radiation of UX. E. Stahel and D. J. Coumou. *Physica*, 2. *pp.* 707–718, *July*, 1935.—The absorption in Pb and Fe of the hard γ-rays (the soft were absorbed in the walls of the apparatus) was determined by means of a high pressure ($17 \cdot 8$ atm. CO_2) ionisation chamber and Geiger–Müller counters. The coefficients are $0 \cdot 83$ cm.$^{-1}$ in Pb and $0 \cdot 47$ in Fe, the wave-length is 13×10^{-11} cm., corresponding to an energy of $0 \cdot 95 \times 10^6$ eV., and an absolute intensity of $1 \cdot 4$ quanta per 100 disintegrating atoms. The rays closely resemble the γ-rays from RaE, and it is suggested that both are connected with the deceleration radiation (*bremsstrahlung*) of the primary β-rays. C. A. S.

3416. Secondary γ-Rays Excited by the Passage of Neutrons through Matter. D. E. Lea. *Roy. Soc., Proc.* 150*A*. *pp.* 637–668, *July* 1, 1935.—Experiments are described which show that when neutrons pass through matter γ-rays are produced. The cross-section per atom appears to increase with the atomic number in a fairly regular manner. The quantum energies of the radiations are for H $3\text{–}4 \times 10^6$ V, for Pb and Fe $1 \cdot 5 \times 10^6$ V. The production of the γ-ray is apparently not usually accompanied by absorption of the neutrons. The neutrons may be inelastically scattered at nuclear encounters, the nucleus being left in an excited state and subsequently returning to the ground state with γ-ray emission. Or it may be that the γ-rays accompany the formation of Fermi radio-elements. The effect of the phenomenon of secondary γ-ray production upon absorption measurements of neutrons is discussed. It is estimated that the relative numbers of primary photons and neutrons emitted from a source of Po + Be are one photon to two neutrons. J. J. S.

See also Abstracts 3219, 3234, 3461, 3610, 3638.

RADIATION.

ABSORPTION AND TRANSMISSION.

***3417. Simple Filters for Isolating Lines in the Mercury Spectrum. A. J. Maddock.** *Journ. Sci. Instruments,* **12.** *pp.* **218–219,** *July,* **1935.**—Simple filters, consisting mainly of solutions of inorganic compounds, are described for isolating the strongest lines in the mercury spectrum from 3022 to 5780 Å. and one transmitting chiefly 2652 Å.
AUTHOR.

See also Abstracts 3381, 3473.

COLORIMETRY.

3418. Interpretation of Data Obtained with Spectrophotometers of the Polarising Type. R. D. Nutting. *J.O.S.A.* **25.** *pp.* 211–215, *July,* 1935.—Many spectrophotometers utilise polarising prisms and determine the reflection factor of the sample by plane polarised light. In general, the reflection factor of the sample is independent of the azimuth of the plane of polarisation, but there are some materials, notably textiles, for which the reflection factor depends upon the azimuth. It can be shown mathematically that, if the reflection factor is determined for two azimuths at right angles to one another, the arithmetic average of the two values is the reflection factor for ordinary, or unpolarised light. This is true regardless of the azimuths selected. Experimental data are presented which indicate the applicability of this principle to the measurement of the colour of textile fabrics. AUTHOR.

***3419. Photometric Colorimeter. F. Anselm and F. Würstlin.** *Zeits. f. techn. Physik,* 16. 6. *pp.* 157–161, 1935.—Describes a new apparatus consisting of a movable lamp placed between two inclined transparent opal glass screens which transmit light, one through a prism and the other through the test solution and prism, to an eyepiece. The instrument is compact and the relative position of the lamp with respect to the two screens is read from a graduated disc, outside the enclosing casing, by means of which the lamp movement is controlled. In order to read the scale, use is made of a lens with an index mark, the lens going inside the apparatus thus obtaining the light necessary for the scale illumination. The most suitable types of lamps are dealt with under the choice of light sources, it being stated that 6- and 12-volt lamps are sufficiently near to the necessary point source of light. After describing the standardisation of the scale the following uses of the instrument are briefly considered: determination of concentration, opacity measurements by absorption and dispersion methods, tintometric measurements, pH values using indicators, and gloss measurements. Finally, suggestions for other uses of the instrument are briefly mentioned. R. C. F.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3420. Photomagnetism. D. M. Bose and P. K. Raha. *Phil. Mag.* 20. *pp.* 145–166, *July,* 1935.—An account has been given previously [see Abstract 1429 (1933)] of the effect of light absorption in changing the susceptibility of paramagnetic solutions containing ions belonging to the iron group. The present paper describes a method of quantitative measurement of the photomagnetic effect therein described, and gives reproducible results. It is based upon the O-tube of Hector and Wills, used to measure the susceptibility of gases. Experimental details are given. The paramagnetic solutions examined contained the ions Cr^{+++}, Co^{++}, Ni^{++}; the orbital moments in the ground state of all these ions are the same, viz. F. These salts are dissolved either in water, dilute HCl or ammonia. From the results it is seen that the photomagnetic effect is the largest in aqueous solutions and the least in HCl solutions. The effect observed for different ions in aqueous solutions is minimum in cobaltous solutions and much greater in solutions containing Cr^{+++} and Ni^{++} ions. Comparison of observed with calculated magneton numbers shows that the difference is smallest for cobaltous ion and largest for Cr^{+++} ion. There appears to be some correlation between the photomagnetic effect shown by aqueous solution of a given ion and the deviation of the experimentally observed value of the magneton number from the calculated one. In HCl solutions this deviation is the maximum and such solutions show very little photomagnetic effect. These results are interpreted in terms of a theory correlating the absorption spectra of a paramagnetic solution with its paramagnetic moment. S. G. B.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3421. Negative Polarisation of Phosphorescence of Adsorbed Dyestuffs. A. Jabłoński. *Acad. Polonaise Sci. et. Lettres, Bull.* 1–2*A*. *pp*. 30–34, *Jan.–Feb.*, 1935. *In German.*—A continuation of previous work [see Abstract 1565 (1935)]. The polarisation of the luminescence of Kautsky phosphors observed in the direction of the exciting light depends on the angle which the direction of vibration in the exciting light makes with the principal axis of the doubly refracting phosphor. At 0° and 180° are two principal maxima, and at 90° and 270° two subsidiary maxima. These results are at room-temperature for what is called the F-N band. At liquid-air temperature this band gives place to another shifted towards the red and called the M-N band. The author now finds that, contrary to previous results of Pringsheim and Wawilow on such low-temperature bands, this one shows polarisation which depends on the azimuth of the sample in a similar way to the room-temperature band. This result is taken to mean that it is not the effective field of the exciting light so much as the absorption which causes the anisotropy in the luminescence. This point is discussed further. J. E.

3422. Decay of Phosphors. W. W. Antonow-Romanowsky. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp*. 105–111, *April* 11, 1935. *In German.*—Simple assumptions based on the Lenard theory of phosphorescence lead to the decay equation $I = I_0\, a^2/(a + t).^2$ This does not agree with the facts. The author develops new equations based on the assumption that the probability of recombination of an electron with an ion depends on the distance between them. These equations are $I = I_0\, a^{\alpha}/(a + t)^{\alpha}$; $I_0 = n_0^2 \overline{P}$; $a = 1/n_0\overline{P}$, where I_0 = the initial intensity and the constants *a* and *α* depend on the crystal radius, and *n* is the initial number of ions or electrons and P is the probability of recombination. The value of *α* is calculated for different crystal radii, the latter being expressed as multiples of the sphere of action of the ions. These values are compared with the way in which *α* varies experimentally with different size crystals from 10μ to 69μ. The theoretical value of *α* is between 1·76 and 2, while the experimental values run from 1·44 to 2. The occurrence of values less than the theoretical minimum is considered due to a variation of the probability function at the surfaces of the crystals. According to the theory only very small crystals should give hyperbolic decay curves with a less than 2. The fact that experimentally large crystals also give such curves is attributed to inhomogeneity, which makes a large crystal effectively a mass of minute crystals. J. E.

3423. Decay of Phosphorescence in Zinc Phosphors in Single Crystals. Part III. W. W. Antonow-Romanowsky. *Phys. Zeits. d. Sowjetunion*, 7. 3. *pp.* 366–379, 1935. *In German.*—The decay of single crystals of zinc phosphors was investigated. The radius of these crystals was 5–50μ. It is shown that there exists a definite dependence of the decay on the magnitude of the crystal. The "large" crystals decay exactly according to the scheme of a bimolecular reaction, whilst the "small" crystals deviate from this scheme, and indeed radiate the absorbed energy the more sparingly the smaller they are. [For Part II see Abstract 4503 (1934)]. J. J. S.

3424. Cathodo - Phosphorescence. M. Servigne. *Comptes Rendus*, 200. *pp.* 2015–2017, *June* 12, 1935.—A sample of calcium tungstate precipitated and dried showed only feeble luminescence. The same sample heated to 800° C. and cooled quickly compares in brilliance with natural Scheelite. X-ray analysis of the two samples showed that the structures were identical except that the crystals of the strongly phosphorescent sample were larger and more perfect. Spectral analysis showed the presence of a trace of Ag. The optimum concentration of Ag was found subsequently to be 1 in 1000. J. E.

See also Abstracts **3374, 3543.**

INTERFERENCE. DIFFRACTION AND SCATTERING.

3425. Measurement of Thickness of Thin Crystalline Plates. K. S. Sundararajan. *Phil. Mag.* 19. *pp.* 1076–1079, *June*, 1935.—A method of measurement which lends itself particularly well to the determination of the thickness of small specimens (in this case flakes of organic crystals, of the order of 0·5 mm.^{2} in area). The slice is placed so that it covers one half of a square aperture, with one of its natural edges horizontal. Light issuing from a horizontal slit is collected by a long-focus lens, and the parallel beam passes through the aperture half covered by the crystal slice. The issuing beam is passed through a nicol oriented so that its principal plane is parallel to one of the extinction directions of the crystal plate. The light is then focussed on to the slit of the spectrograph by a second achromatic lens. The arrangement corresponds to a two-step echelon crossed with the spectrograph, and so gives rise to inclined Talbot bands. Superposed on the bands are vertical fringes of the Edser–Butler type. These are due to the multiple internal reflections in the plate causing the amplitude of the transmitted light to vary with the wave-length. For the Talbot bands $(\mu - 1)d$ is an integral multiple of λ to give a maximum, while for the other bands, $2\mu d$ is an even multiple of $\lambda/2$. Thus the simultaneous observation of the bands allowed by the method renders possible the determination of d. A. C. M.

3426. Doppler Effect in Light Scattered by Liquids. Part I. Variation with Temperature. B. V. R. Rao. *Indian Acad. Sci., Proc.* 1*A. pp.* 765–767, *May*, 1935.—The influence of temperature on the nature of the Doppler effect in light scattered by liquids has been examined and it is found that in the case of CCl_4 at 70° C. the Doppler components become fainter and broader merging with the central undisplaced component which brightens up in intensity. At the temperature of melting ice, the Doppler components become sharper and move away from the central component. [See Abstract 2512 (1935).] AUTHOR.

See also Abstracts 3216, 3252, 3253, 3318, 3541, 3695 3696.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3427. Photographic Development Process. W. Meidinger. *Phys. Zeits.* 36. *pp.* 312–320, *May* 1, 1935. *From the Reichsanstalt.*—Photographic emulsions of pure AgBr, of very large grain but extremely low sensitivity (1/75000 of that of a process emulsion), were prepared using an inert gelatin de-activated by oxidation with iodine. The development process could thus be studied under the microscope at 1000–1500 magnification using a red filter and a desensitiser (both essential) without causing fog during the observations. It was found (i) that the time interval from the commencement to the completion of reduction of a grain of AgBr (the "reduction time") is independent of exposure time, even in the solarisation region, (ii) that exposure modifies the probability of a grain becoming developable in a given time, *i.e.*, affects the induction period necessary before reduction commences, (iii) that both induction and reduction times depend on the developer composition, and (iv) that $(NO_2)'$ acts as a solarisation preventive by reducing the induction times without change in the reduction times. Reference is made to the initial distribution of "silver-specks" in the AgBr grains and the possible application of the method in studying physical development is discussed. L. V. C.

3428. Action of Aqueous Solutions on Latent Photographic Images of Different Ages. C. Jausseran. *Comptes Rendus*, 200. *pp.* 2076–2078, *June* 17, 1935.—Experiments are described which show that the treatment of an exposed photographic plate with distilled water, or with solutions of sodium carbonate or sulphite, arrests the evolution of the latent image, which appears on developing (provided that this takes place within one hour) in the state reached at the beginning of treatment. C. B. A.

3429. Villard Effect. Part III. H. Arens. *Zeits. f. wiss. Phot.* 34. *pp.* 125–135, *June*, 1935.—Compares qualitatively the blackening effects on fine-grained and large-grained films with and without previous exposure to X-rays, and gives contour plans and photographs of three dimensional models of the blackening surface of the Villard effect. The results obtained when compared with those previously given for Laue films [see Abstract 1560 (1934)] indicate that the real Villard effect does not appear except possibly for very high values of X-ray pre-illumination. Finally, the results given in the author's three papers on this subject are briefly summarised. R. C. F.

***3430. Twin Polygraph and Strobograph. A. G. Lowndes.** *Nature*, 135. *pp.* 1006–1007, *June* 15, 1935.—Describes an apparatus designed primarily for the filming of rapidly moving micro-organisms by means of intermittent light. The apparatus consists of a microscope with double eyepiece, a kinema-camera containing a film for each eyepiece being attached for photographic purposes. This ensures that so long as the camera is working the exposure is continuous. An open arc is used as the source of light, the intermittent character of which is obtained by means of a slotted disc placed between the arc and microscope, and rotated at high speed. The speed of the camera is much lower than that of the disc so that each frame of the film will receive several images. Certain polygraph films have been found quite suitable for projection purposes but the strobographic method of producing such films is better. In this method a single slotted disc is used and camera speed tuned to the disc speed. This, however, is only suitable for objects showing rhythmic movements. A comparison of cost using the above method and the usual slow motion method is also given briefly. R. C. F.

3431. Photoelectric Measurement of Photographic Exposure. F. Waibel and W. Schottky. *Zeits. f. wiss. Phot.* 34. *pp.* 88–96, *March*, 1935.—The application of photo-cells of the blocking-layer type (Cu_2O and Se) and of vacuum and gas-filled alkali-metal cells is considered, with special reference to their spectral response, quantum efficiency and linearity of response to varying intensity of incident light. L. V. C.

***3432. Filament Lamps as Photographic Light Sources. F. Zimmermann.** *E.T.Z.* 56. *pp.* 640–643, *June* 6, 1935.—Discusses the use of metal filament lamps as photographic exposure light sources, considering the energy distribution of the lamps in comparison with the spectral sensitivity of the eye, and of various photographic layers. The relative cost of different types of lamps is also briefly dealt with. R. C. F.

***3433. Photographic Plates for Scientific Photography. H. K. Weichmann.** *Zeits. f. wiss. Phot.* 34. *pp.* 136–147, *June*, 1935.—Deals with the properties of the Agfa spectrum plates, considering in particular their use with visible light in spectroscopic, astronomic and similar measurements. This is followed by a section dealing briefly with Agfa ultra-violet plates, after which the author considers the varied types of Agfa infra-red plates. Finally, development and over-sensitising are briefly considered. R. C. F.

See also Abstracts 3276, 3277, 3402.

PHOTOMETRY.

3434. Terminology of Illumination and Vision. *Illum. Research Techn. Paper, No.* 1. [24 *pp.*], (*Second Edition*), 1935.—The first part of this paper explains the principal terms employed in photometry and illuminating engineering. The chief additions which have been made in the present edition are an explanation of the iso-candle diagram, a definition of the brightness unit " apostilb " and an explanation of the colour diagram used to define the colour of any given light. The " colour-temperature " of a light is defined. The term " sill ratio " has been omitted in accordance with modern practice. The second part of the paper describes those terms used in physiology and ophthalmology which are largely employed in literature dealing with the visual characteristics of the eye. This part of the paper remains almost exactly as before. J. W. T. W.

***3435. Photometry of Sodium and Mercury-Vapour Discharge Tubes. P. Clausing.** *Physica*, 2. *pp.* 731–736, *July*, 1935.—A description is given of a combined method with flicker photometer and coloured filters for the measurement of the luminous flux of sodium and mercury-vapour a.c. discharge tubes. The intergrating sphere is used without a diffusing glass window. AUTHOR.

***3436. Telephotometer for Atmospheric Extinction Measurements. W. E. K. Middleton.** *Gerlands Beitr. z. Geophys.* 44. 4. *pp.* 358–375, 1935. *In English*—An instrument has been constructed which measures directly the brightness ratio between two objects nearly in the line of collimation. Such measurements afford a means of calculating the obscuring power of the atmosphere, which may be expressed by a quantity known as the extinction coefficient. By means of filters, this coefficient may be measured for various wave-lengths of visible light. This has been done for three wave-lengths in the blue, green and red respectively, in clear and hazy air in the country. The results show an increasing dependence of extinction coefficient upon wave-length as the air becomes clearer, approaching the values for pure air given by the well-known formula of Rayleigh. For any particular degree of obscurity there is a straight line relationship between the logarithm of the extinction coefficient and the logarithm of the wave-length. From these results it is shown that infra-red photography has the greatest advantage over ordinary photography when the air is very clear, and but little advantage when the range of vision is only a few km. AUTHOR.

***3437. Photoelectric Recording Microphotometer Without Slit or Amplifier. C. Sannié and M. E. Bouty.** *Rev. d'Optique*, 14. *pp.* 107–119, *March*, 1935.—In this instrument the need for slits is avoided by the use of a lamp with a ribbon filament. The coupling of the motions of the record and the plate to be measured employs a lever with a variable fulcrum, which allows the relative speeds to be adjusted over a wide range. A selenium rectifier photo-cell is used. D. H. F.

***3438. Brightness Meter for Self-Luminous Dials. L. F. Curtiss.** *Bureau of Standards, J. of Research*, 15. *pp.* 1–4, *July*, 1935.—A compact, self-contained apparatus is described which can be used to determine the brightness in microlamberts of a self-luminous dial. The arrangement consists of a translucent-glass disc uniformly illuminated from the back by a flashlight bulb. An opaque stencil, cut to match the figures on the dial to be tested, is fitted to the front of the disc. The intensity of illumination and, therefore, the brightness of the face of the glass disc is controlled by a Wheatstone-bridge arrangement which regulates the current through the bulb, supplied by two flashlight dry cells. A milliammeter is connected to show the out-of-balance current of the Wheatstone bridge and may be calibrated directly in microlamberts. The range of the apparatus is from 1 to 50 microlamberts, which upper limit exceeds the brightness of any commercial dials now made. The device is easily portable and can be used to test dials mounted in instrument panels without dismounting them. AUTHOR.

See also Abstracts **3418, 3419, 3431.**

POLARISATION.

3439. Rotation of Plane of Polarisation in Oblique Crystalline Refraction. G. Bruhat and L. Weil. *Comptes Rendus*, 200. *pp.* 2192–2194, *June* 24, 1935.—By a simple geometrical method, an expression can be obtained for the directions of equal rotation of plane of polarisation when light is transmitted through a unixial crystal obliquely to the axis, and it is shown that the directions of minimum rotation are inclined at right-angles to one another. These results are confirmed, within the accuracy of the photoelectric method, by experiments on a plate of spar. The theory is extended to the case of quartz, when the ellipticities of the transmitted beams can be predicted, and the results are again in complete agreement with experiment. [See also Abstract 1118 (1935).] C. B. A.

See also Abstracts **3252**, **3418**.

RADIATION, EMISSION.

3440. Dispersion Theory of the Ionosphere. G. Goubau. *Hochfrequenztechn. u. Elektroakustik,* 45. *pp.* 179–185, *June,* 1935.—A discussion is given of the dispersion formula for an electron gas subjected to an external magnetic field, taking account of electron impacts with neutral gas molecules. The dispersion formula furnishes three types of dispersion curves, which correspond to three wave-length ranges. A number of dispersion curves are given for different impact numbers ν, namely $\nu = 0$, $0 < \nu < \nu_0$ (ν_0 = critical impact number), $\nu = \nu_0$ and $\nu > \nu_0$. The results are applied to wave propagation in the lower layers of the ionosphere and lead to the conclusion either that the air pressure below heights of about 90 km. is less than 0·003 mm. of Hg, or that the dispersion at these heights cannot be attributed solely to electrons, but that ions also are concerned. A. W.

3441. Ionisation Changes During Solar Eclipse. E. V. Appleton and S. Chapman. *I.R.E., Proc.* 23. *pp.* 658–669, *June,* 1935.—The effect of a solar eclipse upon air layers ionised by different solar agencies is described, and the observations of the actual eclipse changes in ionised layers are considered. The conclusion is reached that the normal ionising agency for regions E and F_1 has a speed closely agreeing with that of light; hence it is natural to identify this agency with ultra-violet light (though observations of the kind here considered cannot rule out the possibility that the agency, for one or more of these layers, consists of very high speed corpuscles). Similarly there is fairly definite evidence that ultra-violet light contributes at least a part of the normal region F_2 ionisation, and a suggestion that corpuscles may also contribute. In future eclipses it is very desirable that attention should be specially concentrated on this region F_2. AUTHORS.

3442. Measurements of Upper Atmospheric Ionisation. E. V. Appleton and R. Naismith. *Roy. Soc., Proc.* 150*A*. *pp.* 685–708, *July* 1, 1935.—The critical frequency penetration method is used to make a series of measurements of the ionisation of the regions E, F_1 and F_2 of the ionosphere. The simple theory of ionisation by ultra-violet light from the sun gives a satisfactory explanation of the seasonal variation of the noon values of maximum ionisation in the E_1- and F_1-layers. The variations observed in the F_2-region cannot be explained by this simple theory. The view expressed by certain workers in America that the results for this F_2-layer are totally unreliable is not accepted by the authors who give reasons for believing that the apparently anomalous results obtained for this F_2-layer are chiefly due to a pronounced seasonal variation of molecular temperature. The same reasoning indicates that the summer temperature of the F_2-region of the ionosphere is about 1200° K. Cases have frequently been noted in summer of a special condition of E-layer ionisation in which reflection of waves takes place from both upper and lower surfaces of a thin layer of the ionosphere. Such a state often results in very favourable conditions for long distance high-frequency communication, the usual restriction at the upper frequency limit due to electron limitation in region F_2 being then inoperative. Occasional observations have been made of a region of slightly higher electron density than the normal F_2-region. An Appendix shows that the use of a frequency-modulated transmission, reception being by a sharply tuned receiver whose resonance frequency may be located anywhere within the band covered by the frequency modulation, forms a convenient alternative to the amplitude-modulated pulse transmission technique. F. S. B.

3443. Vibrations in the Ionosphere During 1933 and 1934. J. P. Schafer and W. M. Goodall. *I.R.E., Proc.* 23. *pp.* 670–681, *June,* 1935.—The most important results of daily ionospheric measurements made at Deal, New Jersey, latitude 40° 15′ N., longitude 74° 02′ W. over the period from March, 1933, to May, 1934, are given in this paper and may be summarised as follows: (1) There was a definite correlation between the noon value of ionic density of the F_1 region and magnetic disturbances, a decrease in ionic density being obtained on magnetically disturbed days; (2) The noon value of ionic density of the E and F_1 regions attained a maximum in summer and a minimum in winter whereas the reverse condition, of minimum in summer and maximum in winter, was found for the F_2 region; (3) The time of maximum ionic density of the F_2 region varied with the seasons of the year, occurring near noon in winter and near sunset in summer. The paper also shows a series of virtual height contour maps for the four seasons of the year. AUTHORS.

3444. Velocity of Propagation of Short Wireless Waves. N. Stoyko and R. Jouaust. *Comptes Rendus,* 200. *pp.* 2149–2150, *June* 24, 1935.—The mean velocity found was 287,000 km./sec. The day waves (16 to 18·5 m.) gave a value of 286,700 ± 200 km./sec., while the night waves (25 to 31 m.) gave a value of 287,400 ± 400 km./sec. The results obtained at different seasons of the year are discussed in some detail. The difference between the velocity of super-propagation for day and night paths is explained by the fact that the reflecting layers of the ionosphere are lower for the regions in sunlight than for those in the dark. The difference between the velocities of direct and super-propagation by day may be explained by the fact that the waves giving the direct signal leave the transmitter at an angle with the horizon greater than that for the waves which are super-propagated. A. W.

3445. Absorption of Cosmic Ray Electrons. J. C. Street, R. H. Woodward and E. C. Stevenson. *Phys. Rev.* 47. *pp.* 891–895, *June* 15, 1935.—The authors describe experiments with a triple-counter telescope, controlling a cloud chamber placed between the lower two counters; and with a quadruple-counter telescope with additional counters, so connected as to indicate discharges occurring in any of them simultaneously with quadruple coincidences of the telescope counters, placed adjacent to each of the telescope counters. The results show that coincident discharges in the telescope counters represent the passage of a single ionising particle through all the counters. Absorption data obtained with the quadruple arrangement for Pb, Fe and marble indicate that the absorption as a function of the thickness of absorber on a scale of extranuclear electrons per cm.^{2} is approximately the same in each case. The Pb values have been compared with Anderson and Neddermeyer's electron energy distribution [see following Abstract] to determine what specific energy-loss values for electrons in Pb must be assumed to satisfy both sets of data. D. H. F.

3446. Absorption of Cosmic-Ray Particles. C. D. Anderson and S. H. Neddermeyer. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 171–187, *Physical Society.*—Examination of 104 tracks of cosmic rays photographed with a counter-controlled cloud chamber which exerted selectivity in favour of tracks of higher energy gave the following results. Between 300 × 10^6 eV and 6000 × 10^6 eV (*a*) positives and negatives occur in approximately equal numbers indicating that the majority of the particles are secondaries produced by photon collisions with nuclei, (*b*) 75 % of the tracks have energy less than 4000 × 10^6 eV and 31 % have energy less than 1000 × 10^6 eV. Using plates of C and Pb (of stopping power equal to that of 70 m. of water or five times the earth's atmosphere), the passage of 2400 particles showed the production of an insignificant number of positrons. It is inferred that none of the positrons present in cosmic rays can arise from electron encounters with matter. The greater part of the cosmic-ray electrons at sea-level must therefore be produced by photon collisions with nuclei. Very fine photographs of the tracks are reproduced and instances occur of high energy losses of 100 × 10^6 eV made by electrons presumably in radiative collisons with atomic nuclei. [See preceding Abstract.] F. C. C.

3447. Latitude Effect for Cosmic Rays. P. Auger and L. Leprince-Ringuet. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 188–194, *Physical Society.*—Using 3 similar triple counter devices for measuring coincidences, the latitude effect, evidenced by a decrease in the number of counts as the equator is approached, was examined during a journey from Le Havre lat. 45° N. to Buenos Aires lat. 38° S. and back. The temperature of the apparatus was kept at 30° C. and the barometric pressure was almost constant throughout the voyage. The counters were of length 16 cm., dia. 4 cm., and thickness 1 mm., and the wire was oxidised steel 0·15 mm. in dia. They were filled with A containing a trace of dry air at a pressure of 6 cm. of Hg ; after 18 months they were still in good working condition, although the number of counts registered was less. The ageing was allowed for by averaging readings at the same place on the outward and return journeys. The decrease in counts was about 15 % as the equator was reached, and although the voyage was not continued sufficiently close to the pole to enable the threshold to be observed, the results agreed well with the theories of Störmer, Lemaître and Vallarta, Rossi and Fermi. Using a Pb filter, the constancy of the coefficient of filtration indicated that the production of soft secondaries was constant. Dissymmetry of the distribution curve at low latitudes shows that the greater part of the primary particles is positively charged since the maximum is displaced as for an excess of particles moving from W. to E. F. C. C.

3448. Cosmic Radiation at High Altitudes. P. Auger and L. Leprince-Ringuet. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 195–198, *Physical Society.*—The increase in the intensity of the individual components of cosmic radiation with increase in height has been measured by means of coincidence counters. At the high altitude (3500 m.), measurements were made in a simple shed, and also under a thickness of 4 m. of ice, this being equivalent in mass to 3500 m. of air. It was found that whilst the number of " hard " rays increases slightly in the range covered, the number of soft particles is about trebled. It appears also that the quantities—total ionisation, single impulses, number of soft particles and number of showers—all vary together. AUTHOR.

3449. Absorption of Cosmic Rays. P. M. S. Blackett. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 199–205, *Physical Society.*—Consideration of the results obtained with ionisation chamber, counter and cloud chamber allows the following picture of the absorption of the primary cosmic-ray particles by shower formation to be drawn. Primary particles of electronic or protonic mass, mainly positively charged and of energies up to 10^{10} eV make collisions probably with atomic nuclei with the formation of high energy photons emitted mainly in the forward direction. The effective cross-section, which is probably a few % of the nuclear area for collisions of this type, is proportional to Z the atomic number of the absorber. These photons are, in turn, absorbed with the production of single or multiple positron-electron pairs (showers); the cross-section for this second stage is for heavy elements several times larger than the nuclear area and the absorption depends approximately on Z^2. It is not at present possible to decide whether the fastest primary particles are positrons or protons. F. C. C.

3450. Latitude Effect for Cosmic Rays at Very High Altitudes. I. S. Bowen, R. A. Millikan and H. V. Neher. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 206–224, *Physical Society.*—Discussion of the results of a long series of experiments on cosmic rays with expansion chamber and electroscope at Pasadena, and with electroscopes in aeroplanes to a height of 22,000 ft. and in stratosphere flights to 60,000 ft. extending from Northern Canada to Peru. The main conclusions are (1) incoming photons produce most of the ionisation at sea-level and nearly all the non-field sensitive part of the ionisation above sea-level is due to photons of energy less than 5×10^8 eV, (2) a small part of the ionisation in the equatorial belt is due to secondary electrons of energies up to 10^{10} eV, and these are responsible for the E-W and longitude effects, (3) the resistance of the atmosphere to electrons is 5×10^9 eV due to nuclear encounters, which produce soft photons or low energy secondary electrons and 10^9 eV due to extra-nuclear collisions, (4) at higher altitudes the field sensitive portion becomes progressively more important at higher latitudes: the effect is ascribed to secondary electrons of 8×10^8 to 2×10^8 eV under the influence of the earth's magnetic field. Speculation is made on the cosmic origin of the rays. F. C. C.

3451. Cosmic-Ray Bursts at Different Altitudes. A. H. Compton and R. D. Bennett. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, p.* 225, *Physical Society.*—Experimental work on cosmic-ray "bursts" is described. In particular it is shown that they are not due to ionisation by collision in the apparatus. Some bursts as large as 2×10^8 ions have been observed with low voltage, and as great as 7×10^9 at high altitudes with saturation voltage. AUTHORS.

3452. Cosmic Radiation and Atomic Disintegration. G. Hoffmann. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 226–232, *Physical Society.*—The paper deals with the bursts of ionisation (*Stösse*) which were first observed by the author in 1927. These have been shown to be increased when the apparatus is surrounded by a lead shield, but from the frequency distribution it appears that they are not merely unusually large "showers." Arguments are given to show that they are in no way due to instrumental defects, nor to ionisation by collision. Observations show that the position of the maximum in the frequency curve is characteristic of the material of the shield, and that if a double shield is used, both maxima can be distinguished. The bursts are not due directly to the hard group of cosmic rays. The *stöss*-mechanism is not yet definitely explained, though neutrons and positive and negative electrons probably play a part in the phenomena. AUTHOR.

3453. Results Arising from the Study of Cosmic Rays. B. Rossi. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 233–247, *Physical Society.*—Coincidence experiments are described with 3 counters 25 cm. long and 2·5 cm. dia., arranged in linear and triangular formation respectively. In the former case, with 7 cm. of Pb above the first counter and 45 cm. of Pb between each of the counters, 1·92 ± 0·15 coincidences were obtained per hour while with no Pb above the top counter the number increased to 2·2 ± 0·15. The interpretation is that the number of coincidences due to very fast primary particles is increased when the scattering effect of the top Pb block is removed. Secondaries produce little effect since they are absorbed or scattered by the lower Pb blocks. A short lateral displacement of the central counter reduced the number of counts to 0·29 ± 0·05 coincidences per hour. It was therefore concluded that the triple coincidences were produced mainly by single particles and not by showers. With the counters in triangular formation, experiments at Eritrea 2370 m. showed a soft group which was completely absorbed by 8 cm. of Pb. It is considered that the very penetrating corpuscles are a primary radiation and that they are responsible for the latitude effect whereas the softer group which contains the showers is secondary in origin. No decision is made whether the shower-producing radiation is of primary origin or whether it is produced from the interaction of the penetrating corpuscular group with matter. F. C. C.

3454. Cosmic Radiation. *International Conference on Physics, London,* 1934. *Vol. I. Nuclear Physics, pp.* 247–257, *Physical Society.*—*Discussion* by **G. Bernardini, H. A. Bethe, C. W. Gilbert, V. Posejpal, E. Regener, D. Skobeltzyn.**

***3455. Use of Liquid Dielectrics to Detect Cosmic Ray Bursts. C. Bialobrzeski and I. Adamczewski.** *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A. pp.* 120–128, *March–April,* 1935. *In French.*—The authors describe an ionisation chamber, for use in the detection of cosmic ray bursts, which is filled with highly-purified hexane instead of with gas at high pressure as usual. Results are given which show that more bursts are detected than with the usual apparatus, in spite of a comparatively low sensitivity of the current-measuring apparatus. It is shown that in the presence of Al the bursts occur more frequently than with Pb in the same position. D. H. F.

***3456. Electrostatic Deflection of Cosmic-Ray Particles. E. Lenz.** *Ann. d. Physik,* 23.3. *pp.* 207–239, *June,* 1935.—In the first part of this paper a detailed description is given of the construction of an apparatus for the electrostatic deflection of cosmic-ray particles, the principal components being a condenser containing nitrogen under pressure and an amplifier device for four-fold coincidences in counters. Measurements with this apparatus are then described, the lowest counter being laterally displaced and field strengths of 700 and 70,000 V per cm. being used. The " soft " particles (700 V per cm.) are both positive and negative and have a mean energy of about $7 \cdot 5 \times 10^6$ eV. The softest (5×10^6 eV) show a specific energy loss of about 10^7 V for passage through 1 cm. of lead. The hard particles (70,000 V per cm.) with energies over 10^9 eV are likewise both positive and negative, their proportion in the unfiltered rays being computed to be about 30 %. Measurements with the central position of the counter also indicate the presence of hard and soft particles. The most abundant hard particles have a penetrating power of about 2 cm. of lead (10^8 eV). The hardest " primary " particles show a specific energy loss of 4×10^7 V per cm. of lead. L. A. W.

3457. Cosmic Rays from Nova Herculis. V. F. Hess and R. Steinmaurer. *Terr. Mag.* 40. *pp.* 201–203, *June,* 1935.—The effect of the new star on cosmic ray intensity is tested by means of three Steinke instruments. Two are placed at 2300 m. above sea level (Hafelekar), and one at 600 m. (Innsbruck). The average intensity of a series of days before and after the appearance of the Nova is compared and the results are tabulated. A small increase is observed but this is well within the limits of the mean error with one exception. As the Nova's culmination in the week Dec. 13–20 was near noon, the effect between noon and night is examined. A table shows the results found. As a result of their investigation the authors conclude that any effect due to the Nova cannot be definitely proved by the ionisation method. A. E. M. G.

3458. Analysis of Cosmic Radiation under 8 m. of Earth. P. Auger and F. Bertein. *J. de Physique et le Radium,* 6. *pp.* 253–254, *June,* 1935.—The absorption of cosmic radiation by various thicknesses of Pb up to 20 cm. was investigated by means of three counters, at a depth of 8 m. (equivalent to 2 atmospheres) below the earth's surface. The proportion of the more penetrating component (these authors believe there are two components) is shown to be greater than at the surface. Using the Rossi-Gilbert arrangement for detecting showers, it is found that the number of triple coincidences is not appreciably increased by placing Pb above the counters, and the authors deduce from this that the softer component is responsible for the production of showers. D. H. F.

***3459. Counter-Controlled Cloud Chamber Results at Different Altitudes. P. Auger and P. Ehrenfest, Jr.** *J. de Physique et le Radium,* 6. *pp.* 255–256, *June,* 1935.—A portable counter-controlled cloud chamber is described. Results obtained at 3500 m. above sea level, at the earth's surface and 8 m. below it are briefly described. The results are in accord with the author's theory that the radiation consists of two components, the softer of which is responsible for the production of showers. [See also Abstract 1125 (1935).] D. H. F.

3460. Intensity Decrease of Primary Cosmic Radiation in Different Materials. J. Clay. *Physica,* 2. *pp.* 645–649, *July,* 1935.—A comparison for the decrease of primary cosmic radiation in thick layers of lead, iron, water and air is made. There is a difference for a given material at different latitudes and different heights, that must be bound up with the difference of energy distribution of the particles. When different materials are compared under identical conditions it seems that neither mass density nor electron density gives a satisfactory agreement. It is concluded that the decrease in ionisation for equivalent layers of different material is greater as the density is lower. For great depths in water there is a good agreement between the values obtained in the Gulf of Aden, in the Bodensee by Regener and in the North Sea. AUTHOR.

3461. Absolute Intensity of Cosmic Rays. J. Clay. *Physica*, **2.** *pp.* 650–651, *July*, 1935.—A correction and supplementary note [see Abstract 1600 (1935)]. AUTHOR.

3462. Nature of Cosmic Rays. J. Clay. *Roy. Soc., Proc.* **151***A*. *pp.* 202–210, *Aug.* 1, 1935.—Past experimental results of the writer and others are reviewed and it is considered to be beyond doubt that the primary cosmic radiation is corpuscular in nature. From experiments with a high-pressure ionisation chamber on the latitude effect at different depths below sea-level in a journey from Genoa to Colombo it is concluded that the energy spectrum of the primary corpuscles is continuous. Finally, experiments of Gilbert, Blackett, Anderson, Johnson, the writer and others are considered to give strong support to the view that the corpuscles causing the ionisation produced by showers are not the direct product of the interaction of the primary corpuscular radiation with matter, but are due to the production of an intermediary photon radiation. F. C. C.

***3463. Problems of Technical Light Production. E. Lax, M. Pirani and R. Rompe.** *Naturwiss.* **23.** *pp.* 393–405, *June* 21, 1935.—Methods of technical light production are considered under the headings: excitation by electron collision, radiation by substances in temperature equilibrium, chemico-luminescence, excitation by irradiation. A comprehensive table indicates for each of these methods the main features of the physical mechanism involved, the elements or materials which might be employed and examples of technical light sources already current. Considerable attention is paid to the possibilities of using phosphorescent substances which emit visible light when excited by ultra-violet light. Values for the light output, luminous efficiency and intrinsic brightness of the principal types of light source are given. W. S. S.

See also Abstract 3466.

RADIATION, GENERAL THEORY.

3464. Fundamental Equation of de Broglie's New Photon Theory. R. L. Gomes. *Accad. Lincei, Atti.* **21.** *pp.* 358–364, *March* 3, *and pp.* 443–447, *March* 17, 1935.—The author shows that certain conclusions drawn from the fundamental equation of de Broglie's new photon theory can be obtained more simply by using the laws of matrix algebra. [See Abstracts 278 and 279 (1935).] A. J. McC.

3465. Equation of the Photon. G. Petiau. *Comptes Rendus*, **200.** *pp.* 1829–1832, *May* 27, 1935.—A relativistically symmetrical form of the de Broglie equation for the photon is deduced and discussed. N. M. B.

3466. Temperature and Entropy of Light Quanta. R. v. Hirsch. *Ann. d. Physik*, **22.** 7. *pp.* 609–628, *May*, 1935.—By applying the second law of thermodynamics to the individual processes involved in the Compton effect it is shown that the displaced line should be narrower than the primary line, but this cannot be observed experimentally owing to other factors which tend to broaden the displaced line. A similar thermodynamic argument for the photoelectric effect is found to be possible only if the Wien law for black-body energy distribution is assumed and it then leads to the result that the refractive index of metals must decrease with depth of penetration in accordance with what is actually observed. It is shown that the use of Wien's law in place of Planck's, corresponds to neglecting the entropy contribution associated with the coherence of the radiation emitted by a black body. It is plausible that this coherence entropy should be omitted when considering quantum effects which do not depend on the use of coherent radiation. On the other hand coherence entropy is important where the reciprocal actions of light quanta are concerned as in interference. The analysis leads to conclusions on the natural breadth of spectral lines and on the existence of a long-wave limit for a given black-body temperature beyond which the light quantum notion must break down. For a black-body temperature of 5000° this limit is calculated to occur at a wave-length of 100 μ. W. S. S.

RADIATION, MECHANICAL EFFECTS.

3467. Effect of Light on Brownian Particles. V. Pospíšil. *Ann. d. Physik*, 23. 3. *pp.* 259–276, *June*, 1935.—The present paper deals with the effect of light on Brownian particles and its consequent enhancement of the Brownian movement. The amount of particle movement and the time of such movement are the main factors to be measured and this is accomplished by the passage or transit method of observation using a low-power microscope, counting the number of such transits. The relationship of the square of the particle movement to the time upon which the method of measurement employed is dependent is designated as the diffusion velocity. In three series of observations of 2000 transits of the same particles at two light intensities which were in the ratio of 1 : 10,000, the diffusion velocities after reduction to equal temperature and viscosity conditions were: In strong light of 0·68 W/cm.^{2} with particles 0·7 to 1·2 — 16·7 to 18·5 %, and with larger particles about 7·3 % greater than in very weak illumination. With polarised light, 0·16 W/cm.^{2}, electric light vector parallel component of the diffusion velocity of small particles was 5·2 % and the magnetic parallel component 18·5 % greater than their natural value. This effect is obviously the transformation of the radiant energy into the energy of molecular movement. The causes of this phenomenon are discussed and the full experimental details given. S. G. B.

3468. Dependence of Photophoresis upon Pressure at High Gas Pressures. M. Reiss. *Phys. Zeits.* 36. *pp.* 410–413, *June* 1, 1935.—The positive photophoresis of selenium test-bodies is investigated over a range of gas pressures from 1 to 10·5 atmospheres. The results confirm the 1/p law of Hettner. [See Abstract 2071 (1926).] L. A. W.

REFLECTION. REFRACTION AND DISPERSION.

3469. Refractive Indices of Gas Mixtures. H. Bittel. *Ann. d. Physik*, 23. 1. *pp.* 61–89, *May*, 1935.—A new method of measurement is described in which a Michelson–interferometer is employed and an accuracy of displacement claimed of 2/1000 per band breadth. Mixtures of any two of the following gases: H_2, O_2, A, N_2, CO_2 and SO_2 afford a refractive index which deviates by less than 2×10^{-8} from the value calculated by means of a linear mixture formula. Deviations recorded by previous authors are stated to be invalid, and probably are due to deviations from the perfect gas laws; they are certainly not to be ascribed to interaction between the different gas molecules, since such forces alter the velocity of light by less than 1–2 × 10^{-8} of its value. H. H. Ho.

3470. Variability of Refractive Index in the Interior of Glass. Niuta Klein. *Comptes Rendus*, 200. *pp.* 1848–1850, *May* 27, 1935.—Two circular plates of borosilicate glass 120 mm. in dia. and 30 mm. thick, were heated to 600° in 2 hr., maintained at that temperature for 8 hr., and then cooled in 24 hr. in a current of cold air, one plate being behind the other in the current. Both were examined with an interferometer and lines of equal refractive index plotted. The variations attained 0·00144 as a maximum, that in the plate on which the cold air first impinged being much less than that in the other. C. A. S.

3471. General Formulæ for the Refraction of a Light Pencil. F. Croze. *Comptes Rendus*, 200. *pp.* 2150–2153, *June* 24, 1935.—The formulæ established by Sturm for the refraction of a pencil of light are derived by a simple geometrical method which is alternative to that previously described. [See Abstract 3017 (1935).] C. B. A.

3472. Refractive Index of Alkali Chlorides at Low Concentrations. H. J. Walke. *Phil. Mag.* 20. *pp.* 32–44, *July*, 1935.—The refractive indexes, μ, of solutions of NaCl, KCl, and LiCl were determined for concentrations, c, $<0{\cdot}002\,N$. The relation between μ and c for $c<0{\cdot}0005\,N$ is linear, for $c=0{\cdot}0005-0{\cdot}0002$ it is expressed by $\mu=A+B\sqrt{c}$, where A for NaCl, KCl, and LiCl is respectively 1·3321927, 1·3321990, and 1·3323060, and B 884, 763, and 522 × 10^{-6}. It is suggested that for $c>0{\cdot}0005$ undissociated molecules are present. C. A. S.

3473. Optical Properties of Magnesium Oxide. J. Strong and R. T. Brice. *J.O.S.A.* 25. *pp.* 207–210, *July*, 1935.—It is pointed out that crystals of β-magnesia of optical quality may be obtained in sizes up to 1½ in. dia. Windows for use in spectroscopic furnaces have been prepared from this material. Tests made with these windows show that they resist attack by the vapours of Ca, Na, K and Li. They transmit from 2150Å in the ultra-violet to about 5 μ in the infra-red. The index of refraction varies from 1·8450 at 2536Å to 1·7313 at 7065Å. The dispersion, ν, is 53·5. A preliminary investigation shows that it may be suitable for a quartz-magnesia doublet lens. AUTHORS.

***3474. Correction of Large Optical Instruments. — Violette.** *Rev. d'Optique*, 14. *pp.* 81–106, *March*, 1935.—Large optical instruments are often uncorrected for astigmatism. It is shown that the three principal errors can be corrected simultaneously both for new instruments and for those already existing, by simple means. The general case is first treated geometrically, and is then applied to particular cases for objectives and eye-pieces. Correction of actual objectives by afocal arrangements is described, and also the correction of an eye-piece by a non-spherical surface. C. B. A.

3475. Microscopic Work at Low Temperatures. S. Erk. *Phys. Zeits.* 36. *pp.* 451–452, *July* 1, 1935. *From the Reichsanstalt.*—Difficulties arise with microscope investigations at temperatures below the dew point because the surfaces become coated with dew or hoar frost. These difficulties are overcome by having the surface, simultaneously with the cooling, in an atmosphere free from water vapour. The lower part of the microscope is brought above a cooled evacuated vessel containing the object viewed. With this arrangement microscope investigations can proceed to −120° C. and photographic measurements can be made in polarised light. R. S. R.

✱3476. Thin Cell for Use in Determining the Refractive Indices of Crystal Grains. C. P. Saylor. *Bureau of Standards, J. of Research*, 15. *pp.* 97–98, *July*, 1935.—The use of those immersion methods for determining refractive index in which a regulation of temperature is employed has been seriously limited by the impossibility of obtaining interference figures. A thin cell is described which overcomes this obstacle, so that it is possible to know the exact orientation of the crystal grains which are chosen for identification. AUTHOR.

✱3477. Optical Invertor. A. de Gramont. *Comptes Rendus*, 200. *pp.* 1806–1808, *May* 27, 1935.—A simple optical invertor, consisting of a "roofed" prism (cross-section = square + triangle) whose ends are inclined at 45° to the base is described. [See also Abstract 1133 (1935).] C. B. A.

See also Abstracts 3341, 3613, 3622.

SPECTROSCOPY.

3478. Corrections to "Tabelle der Schwingungszahlen." H. Kayser. *Phys. Rev.* 48. *pp.* 98–99, *July* 1, 1935.—In the tables for interconversion of wave-lengths in air and wave-numbers *in vacuo* (Hirzel, Leipzig, 1925) errors occurred on account of the bad state of the author's eyes. In view of the great usefulness of the tables this list of corrections of errors found by W. F. Meggers, the author and others is published at the request of many spectroscopists. W. J.

3479. Infra-Red Arc Spectrum of Chromium. C. C. Kiess. *Bureau of Standards, J. of Research*, 15. *pp.* 79–85, *July*, 1935.—The new types of plates, sensitive to infra-red light, have made it possible to photograph the arc spectrum of Cr out to 11610 Å. Approximately 200 wave-lengths have been recorded for this region. Most of these are classified as combinations between terms already known and the new terms, mostly of the triplet system, given in the paper. AUTHOR.

3480. Instantaneous Spectrograms of Pb. H. Nagaoka and T. Futagami. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 171–173, *May*, 1935.—Earlier work [see Abstract 2546 (1935)] is repeated using another prism. The photographic film is moved in the direction of the electrodes and the lines corresponding to various stages of ionisation are distinguished by their lengths on the resulting spectrogram. The lines must be sharply focussed upon the film and inductance, capacity and voltage adjusted according to the melting and boiling points of the element investigated. F. S.

3481. Long and Short Spectral Lines. S. Datta and K. Chatterjee. *Indian Journ. Phys.* 9. *pp.* 357–368, *May*, 1935.—An image of an arc, transverse to the slit, is focussed upon it. The lines of Cu have been studied and it is found that the change in relative orientation of the resultant *l* and *s* vectors is large in the case of short lines, but small for long lines. As the pressure is reduced short lines are shortened, long lines for which relative orientation is not zero are short, but lines for which it is zero are still long. F. S.

3482. Excitation of Spectral Lines of H_2 by Electron Collision. A. A. Kruithof and L. S. Ornstein. *Physica*, 2. *pp.* 611–622, *July*, 1935.—The excitation-functions of a singlet and a triplet line of H_2 have been measured. A narrow beam of electrons and a Faraday-cage are used. The electrons are accelerated by a grid at high potential, placed at a short distance from the kathode. This grid is followed by another at a potential only a little above that of the kathode. Almost all ions, formed by the electrons of the beam before its entrance into the cage are captured by this last grid. The optical conditions are such, that the intensities emitted in a horizontal section through the beam are superposed, whereas in a vertical plane a sharp image of the beam is formed. The measured intensities are corrected for: (*a*) The decrease of intensity along the beam. (*b*) Slight differences in pressure and temperature of the gas. It is possible to determine the probability of dissociation of the gas by comparison of the intensities of the molecular lines emitted under various pressures. The intensities are corrected for differences in concentration of the molecules, caused by differences in this probability at various velocities of the electrons. AUTHORS.

3483. Spectrum of Al Vapour Distilled by a Tungsten Coil in a Vacuum. E. Gaviola and J. Strong. *Phys. Rev.* 48. *pp.* 136–137, *July* 15, 1935.—If a tungsten coil, charged with Al, is brought to incandescence in a vacuum of the order of 10^{-5} mm. Hg, it evaporates a cloud of metal, which has been observed to emit a violet-blue light. The luminosity has been analysed and found to be mainly a line spectrum containing Al I, Al II, W and impurity lines. The excitation is produced by collisions with the electrons emitted by the incandescent filament and accelerated by the potential drop across it. λ 3443·6 behaves as an Al arc and not as an Al II line, as commonly listed. AUTHORS.

3484. Absorption Spectrum of Solid Oxygen. Part I. A. Prikhotko, M. Ruhemann and A. Federitenko. *Phys. Zeits. d. Sowjetunion*, 7. 4. *pp.* 410–430, 1935. *In English.*—Several methods are described for producing solid oxygen in its three modifications. The absorption spectrum of solid oxygen has been studied in all three forms in the visible region and in the α- and γ-modifications in the near ultra-violet. The general distribution of the spectrum remains throughout all three modifications similar to that of liquid and compressed gaseous oxygen. The spectra of the α- and β-forms differ from those of the liquid and γ in that apart from continuous absorption structural elements appear. These consist of single lines and widely spaced doublets, in some cases accompanied by groups of closely spaced narrow bands. The problems suggested by these results are stated especially as regards the origin of the spectrum. AUTHORS.

3485. Regularities in the Cu III Spectrum. L. and E. Bloch. *Comptes Rendus*, 200. *pp.* 2017–2019, *June* 12, 1935.—Although the multiplets of CoI and Ni II are mostly interpreted, those of Cu III, the third member of this isoelectronic series, are not. The authors cannot agree with Rao's suggestions [see Abstract 1590 (1934)] with regard to one of the quadruplets. They give here a table showing their present interpretation of the multiplets based on their own data of 1914 and 1925. J. E.

3486. Spectrum of Ionised Tellurium, Te III. S. G. Krishnamurty. *Roy. Soc., Proc.* 151*A*. *pp.* 178–188, *Aug.* 1, 1935.—The spectrum of Te has been photographed over a wide range, using various sources with large- and small-dispersion instruments. With data thus obtained, supplemented by those from photographs of the Schumann region, taken with a high-dispersion Siegbahn vacuum spectrograph, it has been found possible to identify the 5*p*, 6*p*, 5*d*, and 6*s* terms in the structure of the Te III spectrum. More than 100 lines have entered the scheme of classification. Agreeing in its general features with that of

Se III, this spectrum exhibits marked deviations from the usual interval and intensity rules, thus indicating a departure from the normal Russell-Saunders coupling. The value 24,655 cm.$^{-1}$ for the lowest term leads to a second ionisation potential of about 30·5 V for Te. AUTHOR.

3487. Absolute Light Yield of Sodium D Lines. W. Christoph. *Ann. d. Physik*, 23. 1. *pp.* 51–60, *May*, 1935.—The absolute light yield of the Na-D-lines, when excited by electron impact using Hanle's opposed field method, is investigated photoelectrically. Large absorption losses are avoided by working at the lowest possible pressure. The diminution of intensity of the D lines is also measured. The value of light yield is about four times that previously found by Ornstein [see Abstract 2083 (1932)]. F. S.

3488. Intensity Measurements in the Fine Structure of the Balmer Line, Hα. L. S. Ornstein, H. Lindeman and J. A. Vreeswijk, Jr. *Physica*, 2. *pp.* 541–550, *June*, 1935. *In German.*—The intensity ratio of the fine structure components of the Hα Balmer line is measured as a function of the velocity of the exciting atoms by a previously described method [see Abstract 1889 (1933)]. The measured ratio agrees for low velocities of the exciting electrons with that calculated from the quantum-mechancial theory of transition and excitation probabilities. The ratio is, however, found to be almost independent of the velocity of the exciting electrons whereas theory predicts an increase in the intensity ratio of the short to the long-wave component. For high exciting velocities the occupation of the excited states approaches that of a statistical distribution. This may perhaps be ascribed to the influence of external electric fields. J. E. K.

3489. Intensity Distribution and Half-Value Breadth of Neon Lines. Part I. W. Schütz. Part II. W. Schütz, H. Schillbach and K. Krämer. *Phys. Zeits.* 36. *pp.* 403–409, *June* 1, 1935.—New intensity measurements are made upon the neon lines $p_1 - s_2$ (5852 Å), $p_4 - s_5$ (5945 Å) and $p_4 - s_4$ (6096 Å) using capillary discharge tubes of dia. 3 and 1·5 mm. A greater half-value breadth for the line involving the unstable s_2-term is not observed unless the tube is cooled in liquid air. From the intensity at the foot of the lines at room-temperature an upper limit is derived for the ratio of natural breadth to Doppler breadth. The value so obtained is at least 10 times smaller than that reported by Lau and Johannesson. [See Abstract 3285 (1934).] L. A. W.

3490. Intensity Distribution of Spectral Lines Excited in a Molecular Ray. R. Minkowski and H. Bruck. *Zeits. f. Physik*, 95. 5–6. *pp.* 274–283, *June* 17, 1935.—The intensity distribution of spectral lines excited in a molecular ray is calculated. The estimate of the intensity produced by excitation by electron collision shows, in agreement with preliminary experiments with a Cd atomic ray, that the molecular ray is not only a suitable light source for the production of sharp spectral lines but also provides sufficient intensity for investigations of excitation functions. [See following Abstract.] J. E. K.

***3491. Intensity Distribution in the Red Cd-Line Excited in a Molecular Ray by Electron Collision. R. Minkowski and H. Bruck.** *Zeits. f. Physik*, 95. 5–6. *pp.* 284–298, *June* 17, 1935.—An apparatus is described in which a molecular ray of Cd is produced and excited by electron collisions. The intensity distribution of the red Cd-line is measured and found to agree well with the theoretically calculated distribution [see preceding Abstract]. The measurements determine the true intensity distribution of the line, free from Doppler broadening. The line comprises several components within a range of 2×10^{-2} cm.$^{-1}$ which, on account of the large natural width of the line, cannot be resolved. It is concluded from examination of the distribution that the isotope displacement is probably the determinant factor with a distance between the lines of two neighbouring even isotopes of about 5×10^{-3} cm.$^{-1}$

J. E. K.

3492. True and Apparent Breadth of Spectral Lines. R. Minkowski and H. Bruck. *Zeits. f. Physik,* 95. 5–6. *pp.* 299–301, *June* 17, 1935.—The connection between true and observed distribution of intensity of a spectral line on observation with the Fabry-Perot interferometer is given. In consequence of the inaccuracy of the graphic integration which has been previously made use of in calculations which gave the relation between observed, true, and apparatus half-width for large values of the ratio of true to apparatus half-width a noteworthy error has occurred. This error is corrected in the present paper.

J. J. S.

3493. Hyperfine Structure of HgH Bands. S. Mrozowski. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 24–29, *Jan.–Feb.*, 1935. *In French.*—The hyperfine structure of three band systems of HgH, $^2\Pi_{1/2} \rightarrow {}^2\Sigma$, $^2\Pi_{3/2} \rightarrow {}^2\Sigma$, and $^2\Sigma^* \rightarrow {}^2\Sigma$, is investigated with crossed Lummer-Gehrcke plates and a large Hilger spectrograph, the spectrum being excited in a previously described Hg-arc source [see Abstract 1619 (1935)]. In the first two band systems each line comprises four components, the same sequence of intensities being preserved in each line. This structure is considered to be due to the superposition of two effects, namely, a hyperfine structure (in the atomic sense) which is the same for all lines of a system, and a normal band isotope effect which varies in different parts of the spectrum. Each line of the $^2\Sigma^* \rightarrow {}^2\Sigma$ system comprises five components, the four principal components are ascribed to the even isotopes 198, 200, 202 and 204 of Hg and the fifth to one or both of the two odd isotopes 199 and 201 which possess magnetic moments different from zero.

J. E. K.

3494. Line Absorption of Hg Vapour for Hyperfine Structure Components of the Line 2537Å. K. Zuber. *Helv. Phys. Acta,* 8. 4. *pp.* 370–380, 1935. *In German.*—Measurements of the line absorption of individual hyperfine structure components of the Hg line 2537Å lead to results which are in agreement with Schüler and Keyston's fine-structure analysis under consideration of the correction given by Inglis. This agreement is however only reached by assuming, in contradiction of Mrozowski, that the mean life period of the 2^3P_1 level has the same value for all isotopes. The absorption coefficient $K\lambda_0$ of the whole line is calculated from the absorption of the individual components. This value agrees well with the measurements of Kunze and Ladenburg–Wolfsohn.

J. E. K.

3495. Hyperfine Structure of BiII Lines. S. Smith and J. S. Beggs. *Canad. J. of Research,* 12. *pp.* 690–698, *May,* 1935.—The hyperfine structure of nine lines of Bi II and one line of Bi III has been measured by means of a quartz Lummer plate and a glass Lummer plate used in conjunction with a Hilger E 1 spectrograph. The light source was a water-cooled hollow-kathode discharge in helium. Of the lines investigated the hyperfine structure of some had already been resolved either totally or in part by Fisher and Goudsmit using a 21 ft. grating, but for the lines λ6808, 6600, 4272 and 4259 the hyperfine structure has been obtained for the first time. The separation factors for the terms $6p_{\frac{1}{2}}5f_{3\frac{1}{2}}14_4$ and $6p_{\frac{1}{2}}6d_{2\frac{1}{2}}8_3^0$ have been found. The interaction constants of the $5f_{2\frac{1}{2}}$, $5f_{3\frac{1}{2}}$, and $6d_{2\frac{1}{2}}$ electrons have been calculated. AUTHORS.

3496. Deviation of the Lutecium Nucleus from Spherical Symmetry. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 95. 5–6. *pp.* 265–273, *June* 17, 1935.—The hyperfine structures of the Lu II lines λλ6463, 5984, 4840, 6222, 4994 and 5477 are investigated and analysed in term schemes. From the number and intensities of the hyperfine components it is concluded that the nuclear moment is $I = 7/2$, and not 5/2 as previously reported. Many considerable deviations of the hyperfine structure levels from the Landé interval rule are found in the terms of Lu 175 which are ascribed to asymmetry of the Lu nucleus. The deviations follow a $\cos^2$-law very closely. J. E. K.

3497. Hyperfine Structure Formulæ for the Configuration p^3s. M. F. Crawford and L. A. Wills. *Phys. Rev.* 48. *pp.* 69–73, *July* 1, 1935.—Hyperfine structure interval factor formulæ for the states of p^3s are derived by the method of Breit and Wills. The formulæ for intermediate coupling are expressed in two forms: one involving the coefficients C's, the other the coefficients K's, corresponding to the representation of the functions of the states in intermediate coupling as a linear combination of the (jj) and the (LS) functions, respectively. The (jj)—(LS) transformation matrices as well as the interval factor formulæ for (jj) and (LS) coupling are also given. AUTHORS.

3498. Matrix Elements of the Alkali Atoms. A. Thoma. *Zeits. f. Physik*, 95. 7–8. *pp.* 539–554, *June* 26, 1935.—In continuation of former theoretical work on absorption continua of these atoms [see Abstract 2580 (1935)] the author here sets out first the approximation functions for the radial parts of the discrete eigenfunctions and then the matrix elements corresponding to transitions from the various discrete states to the continuum state. The error in the evaluation of the matrix elements arising from the use of the approximation functions instead of the calculated discrete eigenfunctions is estimated and discussed. Three corrections to the former paper are appended. W. J.

3499. Spectrum of Neodymium Oxide Vapour. G. Piccardi. *Accad. Lincei, Atti*, 21. *pp.* 584–588, *April* 28, 1935.—With improved experimental conditions with a jet of flame of about 50 cm. length which could be regulated in temperature, a more complete and intense spectrum of neodymium oxide in the state of vapour has been obtained, and the results are given in a table of over 200 bands. These are almost all in the visible region from the red to the green; only a few are in the violet region, and none in the ultra-violet. The bands are not resolvable into lines; many of them are so fine that they might be confounded with atomic lines. Measurements of wave-length have shown that the coincidences between lines of Nd and bands of the oxide are so rare that the superposition of the atomic and the molecular spectrum is inconceivable. [See following Abstract.] J. J. S.

3500. Spectrum of Samarium Oxide Vapour. G. Piccardi. *Accad. Lincei, Atti*, 21. *pp.* 589–593, *April* 28, 1935.—With the improved arrangement used in the case of the oxide of neodymium [see preceding

Abstract] new measurements of the spectrum of the oxide of samarium have been made. The spectrum obtained was more complete and complex and a list of about 200 bands is given. These are confusedly spread in the visible region, the most brilliant being in the red. Very few bands are in the blue and violet region, and none in the ultra-violet, analogously to what was observed in the case of neodymium oxide. The bands were not resolvable into lines with the dispersion of the spectrograph used. J. J. S.

3501. Band Spectra of Ionised Hydrogen Halides. Part I. HBr^+. F. Norling. *Zeits. f. Physik,* 95. 3–4. *pp.* 179–188, *June* 4, 1935.—A band system of HBr^+, developed in d.c. discharge (0·8A.) through HBr vapour at low pressure in a water-cooled hollow-kathode tube, is investigated in grating second order (1Å/mm.). Like the analogous $^2\Sigma \rightarrow {}^2\Pi_{inv}$ system of HCl^+, it consists of red-degraded bands at λλ 3000 – 4000 without prominent heads. Four sub-bands are analysed; each consists of the six branches expected for a $^2\Pi$ state close to *Case a*. Two at λλ 3272, 3582 form a 1, v'' band, and two at λλ 3421, 3762 a 0, v'' band with same v'', which may be 0. Separation $^2\Pi_{\frac{1}{2}} - {}^2\Pi_{1\frac{1}{2}} = 2653$ cm.$^{-1}$ (*cf* 644 for HCl^+), and other constants are :—

Level :	$^2\Pi_{1\frac{1}{2}}(v''=0\ ?)$	$^2\Pi_{\frac{1}{2}}(v''=0\ ?)$	$^2\Sigma\ (v'=0)$	$^2\Sigma\ (v'=1)$
B (cm.$^{-1}$) :	7·93	7·98	5·85	5·60
r (Å) :	1·46	1·45	1·70	1·74

Λ doubling is typical *Case a*; very small (much less than for HCl^+) in $^2\Pi_{1\frac{1}{2}}$, and very large (much greater than for HCl^+) and $= 2p\ (J + \frac{1}{2}) + const.$ in $^2\Pi_{\frac{1}{2}}$ with $p = 2\cdot03$ cm.$^{-1}$. Spin doubling in $^2\Sigma = \gamma\ (K + \frac{1}{2})$ with $\gamma = 2\cdot08$ and 2·01 cm.$^{-1}$ for $v' = 0$ and 1 respectively; thus $p = \gamma$, a condition of van Vleck's "pure precession." W. J.

3502. Emission Spectrum of Te_2. E. Olsson. *Zeits. f. Physik,* 95. 3–4. *pp.* 215–220, *June* 4, 1935.—It is shown that each band of the Te spectrum has not less than 5 heads. They can be explained as isotope effects. The isotope separation introduces a correction into the oscillation formula. F. S.

3503. Band Spectra of the Hydrides of Lithium. Part II. Li^7H. F. H. Crawford and T. Jorgensen, Jr. *Phys. Rev.* 47. *pp.* 932–941, *June* 15, 1935.—Rotational analysis of 26 bands of the $^1\Sigma \rightarrow {}^1\Sigma$ system of Li^7H yields the following values of the more important constants (H = coefficient of $J^3\ (J + 1)^3$) :—

State	ω_e	$x_e\omega_e$	$y_e\omega_e$	B_e	B_0	$10^4 D_e$	$10^8 . H_e$	
Excited	234·41	—28·95	—4·185	2·8186	2·8536	15·8	100±30	cm^{-1}.
Ground	1405·65	+23·20	+0·1633	7·5131	7·4067	—8·617	11·4	cm^{-1}.

The anomaly of the upper state is ascribed to an anomalous potential curve, no evidence of l–uncoupling being found. Corrections are made to the value and expression for H_v given in Part I for Li^7D [see Abstract 1652 (1935)]. The v numeration, which agrees with Nakamura's, is such that the maxima of the curves $B_v' : v'$ and $\Delta G'(v' + 1) : v'$ occur at approximately the same energies for Li^7H as for Li^7D. The electronic isotope shift of the system–origin is given provisionally as 0·0 (±0·5) cm^{-1}. W. J.

3504. New Band Systems of CuH. T. Heimer. *Zeits. f. Physik,* 95. 5–6. *pp.* 321–327, *June* 17, 1935.—Known electronic states of CuH are $X^1\Sigma$, $A^1\Sigma$, $B^1\Sigma$, $C^1\Pi$, $D^1\Pi$, $E^1\Pi$, and the previously recorded band systems are the well-known A → X at λ 4280, etc., Stücklen's band

B ⇌ X at λ 2240, and the ultra-violet system B → X described by A. Heimer and the author [see Abstract 4515 (1933)]. Two additional ultra-violet systems C → X and D → X are here described. The newly analysed bands are λλ 3586 (3,0) and 4127 (3,2) in A → X; λλ 3590 (1,0), 3804 (0,0) and 4200 (2,3) in B → X; λλ 3501 (1,0), 3689 (0,0) and 3962 (0,1) in C → X; and λλ 3576 (0,0) and 3832 (0,1) in D → X. As expected in $^1\Pi \rightarrow {}^1\Sigma$ the order of branch intensities in the last five is $Q \gg R > P$. Constants for $c^1\Pi$ are $T_0 = 27101{\cdot}3$ cm.$^{-1}$ (= 3·343 V.), $\omega_{\frac{1}{2}} = 1457$, $B_0 = 6{\cdot}383$, $B_1 = 6{\cdot}056$ cm.$^{-1}$, $r_e = 1{\cdot}684$Å; and for the $D^1\Pi$ state, $T_0 = 27957$ cm.$^{-1}$ (= 3·449V.), $B_0 = 6{\cdot}070$ cm^{-1}, $r_0 = 1{\cdot}749$Å. The Λ doubling is $\gamma J\,(J + I)$ with $\gamma = 0{\cdot}022$ and $0{\cdot}060$ for $v = 0$ and 1 respectively in $c^1\Pi$, and $\gamma = 0{\cdot}055$ for $v = 0$ in $D^1\Pi$.

W. J.

3505. Band Spectrum of BiH. A. Heimer. *Zeits. f. Physik*, 95. 5–6. *pp*. 328–336, *June* 17, 1935.—This spectrum, hitherto only briefly recorded by Hulthén and the author, is developed with great intensity and purity in a heavy a.c. discharge through H_2 and Bi vapour in a silica tube. Most of the bands are photographed in 1 Å/mm. dispersion and others in 5 Å/mm. The bands analysed are λλ 6814 (0,1) 6792 (1,2) and 6118 (0,0) of system $B^1\Sigma \rightarrow A^1\Pi$; λλ 5089 (0,1), 5071 (1,2), 4698 (0,0), 4697 (1,1), 4361 (1,0) of $B^1\Sigma \rightarrow X^1\Sigma$; and λλ 5171 (0,1) and 4842 of $b^1\Sigma \rightarrow a^1\Sigma$. Constants evaluated are:

State	$T_e+G(0)$	ω_e	$x_e\omega_e$	B_0	a	-10^4D_0	r_e (Å)
$b^1\Sigma$	20647+a			c.3·88			(r_0=2·08)
$a^1\Sigma$	?	($\omega_{\frac{1}{2}}$=1313·6)		4·31	0·10		1·96
$B^1\Sigma$	21278·33	c.1728	c.42·6	5·214	0·187	2·00	1·782
$A^1\Pi$	4936·58	1740·7	35·8	5·181	0·159	1·91	1·790
$X^1\Sigma$	0	1699·5	31·9	5·063	0·159	1·83	1·811

Λ doubling in $^1\Pi$ is $\gamma J\,(J + 1)$, with $\gamma = 0{\cdot}020$, $0{\cdot}019$, $0{\cdot}019$ for $v = 0, 1, 2$, in close agreement with γ calculated by Mulliken and Christy's formula on van Vleck's theory.

W. J.

3506. Molecular Emission Spectra of Metallic Salts. P. Mesnage. *Comptes Rendus*, 200. *pp*. 2072–2074, *June* 17, 1935.—The h.f. electrodeless discharge is applied to the heated vapours of metallic salts. For most salts, the h.f. field alone is incapable of producing ionisation but this is achieved by first admitting a trace of a rare gas. The spectrum emitted by the salt depends on the pressure. At low pressures (0·1 mm.) that of the metal predominates; at 1 to 2 mm., bands develop. Preliminary results are given for AgCl, $ZnCl_2$ and $NiCl_2$ as follows:—AgCl—Intense bands originating at 3166 Å. Two other series of unknown origin, one in the visible and one in the ultra-violet, all degraded towards the red, are observed. $ZnCl_2$—The arc spectrum of zinc is obtained, together with a very extended spectrum containing groups of bands from beyond the limit of sensitivity of panchromatic plates down to 3400 Å. Some of these bands are symmetrical, others degraded towards the red. Some can be resolved into fine lines. 28 maxima are measured between 4391 and 3620 Å, and this spectrum is attributed to the $ZnCl_2$ molecule. $NiCl_2$—The spectrum is very complex. The arc spectrum of Ni and a series of visible bands, attributed to NiCl, are identified.

C. B. A.

3507. Excitation of Végard-Kaplan Bands by Electron Bombardment of a Mixture of Argon and Nitrogen. R. Bernard. *Comptes Rendus*, 200. *pp*. 2074–2076, *June* 17, 1935.—The spectrum emitted by a mixture of A and N_2 under bombardment by electrons of less than 20 V energy is studied at pressures between 0·1 and 0·6 mm., the partial pressure of N_2 varying from 10^{-1} to 10^{-5} of the total pressure. Under these conditions a number of lines and emission bands not belonging to the spectrum of A I is obtained, and the whole spectrum has a striking resemblance to that of the night sky. The new bands, extending from 3500 to 5500 Å, are identified as the Végard-Kaplan bands, and are tabulated together with calculated values based on the Herzberg formula proposed by Cabannes and Dufay [see Abstract 2482 (1935)], good agreement being obtained. Evidence is given to show that the bands originate from molecules of N_2 in the metastable state. C. B. A.

3508. Infra-Red Absorption Spectra of Nitriles. F. K. Bell. *Am. Chem. Soc., J.* 57. *pp.* 1023–1025, *June*, 1935.—The infra-red absorption spectra of acetonitrile, *n*-butyronitrile, *n*-valeronitrile, isocapronitrile, phenylacetonitrile, benzonitrile, α-naphthonitrile and succinonitrile have been examined between 1·0 and 12·0 μ. The nitriles are characterised by a well-defined absorption band at 4·4 μ in alkyl nitriles and at 4·5 μ in aryl nitriles. This band is attributed to the CN linkage. The possibility that 7·0 μ may also be a region of characteristic absorption has been indicated. AUTHOR.

3509. Low-Frequency Fundamental Bands of Methyl Chloride, Methyl Bromide and Methyl Iodide. E. F. Barker and E. K. Plyler. *J. Chem. Phys.* 3. *pp.* 367–368, *July*, 1935.—The parallel type bands ν_5 for CH_3Cl, CH_3Br and CH_3I have been found at λ 13·7, 16·4 and 18·8μ, respectively, the rotation lines of the chloride band being partially resolved. The iodide band has a particularly sharp zero branch suitable for use in calibration. Both the chloride and bromide bands are complicated by isotopic effects, the separations being 6 cm.$^{-1}$ and 1 cm.$^{-1}$. AUTHORS.

3510. Absorption Spectrum of Metastable Nitrogen Molecules. A. A. Frost and O. Oldenberg. *Phys. Rev.* 48. *pp.* 66–68, *July* 1, 1935.—Previous failures to observe the absorption spectrum of metastable N_2 might be explained on the basis of more recent information by the position of the spectrum in an infra-red range in which plates are less sensitive and, therefore, the application of high resolving power is difficult. Since at this laboratory a special equipment for the investigation of very faint absorption spectra had been developed for another purpose the problem mentioned was reinvestigated under most favourable conditions with the newly developed plates, types *Q* and *Z*, of the Eastman Kodak Company. Again no absorption spectrum was observed. AUTHORS.

3511. Infra-Red Absorption of Intramolecular Isomers. J. Errera and P. Mollet. *J. de Physique et le Radium*, 6. *pp.* 281–288, *July*, 1935.—The infra-red absorption of certain pure liquids has been studied to see if certain characteristic bands disappear or are modified due to molecular isomeric change. By working at several temperatures it is found that certain phenomena appear which constitute important arguments for or against such a change. These phenomena are discussed in a number of cases. F. S.

3512. Absorption Spectra of Na and K in the Melts of Their Halogen Salts. E. Mollwo. *Göttingen Nachrichten, Fachgruppe II*, 1. 18. *pp.* 203–207, 1935.—In order to study the influence of melting on colour centres in alkali halide crystals, the absorption spectra of Na and K dissolved in their molten halides are measured. It is found that the colour centres are replaced by new absorption centres which have a wide absorption band, the position of which depends only on the nature of the metal and not at all on the solvent. C. B. A.

3513. Spectra of SnCl and $SnCl_2$. H. Trivedi. *Indian Journ. Phys.* 9. *pp.* 331–345, *May*, 1935.—The absorption spectrum of $SnCl_2$ vapour has been studied over the visible and quartz region. The photographs show three regions of continuous absorption having their long wave-length beginnings at λλ 4129, 3759, 2883. These results are explained by assuming the optical dissociation of $SnCl_2$ into Cl and SnCl, the latter being in the various states designated by the author as $^2\pi_{\frac{1}{2}}$(A), $^2\pi_{1\frac{1}{2}}$(B), ½ and 1½ (C, D). From the above results and other available data it is argued that the chemical binding in SnCl and $SnCl_2$ is ionic in nature. A fluorescence experiment was also tried to obtain support for the above view. The $SnCl_2$ vapour was illuminated with the radiation 2535 Å of the mercury arc and fluorescence photographed. After an exposure of 50 hours, faint fluorescence patches were visible, beginning at 3480 and 3750 Å. The experiment is still in progress. AUTHOR.

3514. Absorption Spectra of Substituted Benzenes. Part VI. Methyl Benzenes and Xylonitriles. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 29. *Abt.B.* 3. *pp.* 170–177, 1935.—In continuation of previous work [see Abstract 2505 (1934)] the absorption spectra of eleven methyl benzenes and five xylonitriles are recorded. In the former class, the results are in good accordance with the " calculation rule " previously proposed when account is taken of the " ortho error," and the intensity relationships are similar to those of the chlorobenzenes ; but the spectra of the xylonitriles cannot be predicted on the basis of the rule. There is, however, some regularity in the displacements of the bands which leads to the hope that a formula for calculating the position of the bands of this type of compound will also be found. C. B. A.

3515. Ultra-Violet Absorption Spectra of Acetylene, Anthracene and Phenanthrene. H. Göpfert. *Zeits. f. wiss. Phot.* 34. *pp.* 156–173, *July*, 1935.—The ultra-violet absorption spectra of anthracene and phenanthrene vapours and of acetylene are examined under high dispersion and the bands tabulated. No fine structure is observed in those of anthracene, but the band-heads can be represented by a simple formula. The spectrum shows some similarity with those of benzene and naphthalene ; and it is displaced by about 300 Å towards the red from the spectrum of anthracene crystals. In addition to several diffuse bands, which can be divided into three groups of which two are similar to those of the crystals, the spectrum of phenanthrene contains two quite sharp systems, and the spectrum shows no similarity with that of anthracene. In the acetylene spectrum, about 70 band heads are tabulated, mostly with P and R branches (no Q branch is observed). The fine structure in eight bands is recorded and five term schemes are identified. The band of shortest wave-length is analysed, and a moment of inertia, $J = 25{\cdot}61 \times 10^{-40}$ gm./cm.², is obtained for the excited state, whilst the constant B″, giving that in the ground state, is 1·18, in good agreement with Mecke's value of 1·77. C. B. A.

3516. Spectrum of CO^+ (Comet-Tail Bands). H. Bulthuis. *K. Akad. Amsterdam, Proc.* 38. 6. *pp.* 604–617, 1935.—Rotational analyses of the stronger branches of the 9–0, 10–0, 11–1, 12–1, 13–1, 13–2 and 14–2 bands of the Comet-tail system $A\,^2\Pi_{inv} \rightarrow X\,^2\Sigma$ are made, which, with results from other CO^+ bands [see Abstract 3735 (1934)], give :

State :	X $^2\Sigma$	A $^2\Pi_{1\frac{1}{2}}$	A $^2\Pi_{\frac{1}{2}}$	B $^2\Sigma$
B_0	1·967	1·614	1·652	1·782
α	0·0214	0·0192	0·0192	0·0360

Perturbations observed in the 13–1 and 13–2 bands show that the perturbed level is $v = 13$ of A $^2\Pi_{\frac{1}{2}}$, and application of Biskamp's band-head formula [see Abstract 200 (1934)] identifies the perturbing level as $v = 18$ of X $^2\Sigma$. Rotational levels of many J-values are affected, as in the 8–0 band [see Abstract 1499 (1933)]. Agreement with Ittmann's theory is excellent. The dissociation products of B $^2\Sigma$ are now believed to be the same as those of A $^2\Pi$ and X $^2\Sigma$. W. J.

3517. Band Spectrum of AlBr. P. C. Mahanti. *Indian Journ. Phys.* 9. *pp.* 369–382, *May,* 1935.—The spectrum of AlBr has been photographed with moderately high dispersion. The vibrational analysis of the bands is in agreement with that given by Crawford and Ffolliott. Approximate values of the vibrational constants have been calculated from the Q head data. The identity of the emitter is confirmed by the close agreement between the calculated and observed isotopic displacements. Predissociation has been found to be operating at the upper state above $\nu' = 3$ and is attributed to the interaction of a Heitler-London level whose products of dissociation are probably a normal Al atom ($3^2P_{\frac{1}{2}}$) and an excited Br atom ($5^2D_{1\frac{1}{2}}$). AUTHOR.

3518. Band Systems and Structure of CaCl. R. K. Asundi. *Indian Acad. Sci., Proc.* 1*A. pp.* 830–840, *May,* 1935.—Until recently four electronic levels X, B, A, C at 0, 1·99, 2·08 and 3·28 V respectively, and three band systems, the red doublet A → X, the orange B → X and the ultra-violet C → X, have been known for CaCl. Parker [see Abstract 1651 (1935)] has recorded three weak systems, of which one, D → X, locates the level D at 4·2 V. Band-heads in two sequences of the red doublet system, and in two of the orange system, have been measured by the author in high dispersion (21 ft. grating, first order). These systems are assigned to $^2\Pi \rightarrow {}^2\Sigma$ and $^2\Sigma \rightarrow {}^2\Sigma$, but are found to have no vibrational energy function in common. The author considers the two transitions to be A → X and D → B. Some of the red bands hitherto attributed to CaCl are due to CaO. W. J.

3519. Spectrum of AgD. P. G. Koontz. *Phys. Rev.* 48. *pp.* 138–140, *July* 15, 1935.—The spectrum of AgD has been photographed at high dispersion with an Ag arc in an atmosphere of D_2 as a source. Quantum analyses of the 0,0 and 1,1 bands are presented. The value $B_e = 3 \cdot 2595$ is found for the lower state. Comparing this with the corresponding value for AgH, the ratio B_e^i/B_e for the two isotopic molecules is 0·50511, whereas the ratio of the reduced masses, by using Aston's latest values for the masses of the H and D atoms, is 0·50497. Calculation of the corrections to B_e for the anharmonic oscillator as given by J. L. Dunham shows them to affect the B_e ratio inappreciably. AUTHOR.

3520. Intensities of Vibration Rotation Bands. Jenny E. Rosenthal. *Nat. Acad. Sci., Proc.* 21. *pp.* 281–285, *May,* 1935.—The exact expression for the probability of any transition $\nu' \rightarrow \nu''$ is derived by a simple mathematical method for the case of a Morse potential function between the nuclei. From the calculated probabilities an explicit expression is derived for the ratio of the intensities of the $1 \leftarrow 0$ and $\nu' \leftarrow 0$ bands and numerical values are obtained for HCl, HBr and HF using the most recent values of the vibration constants. The calculated value

$1 \cdot 76 \times 10^{-2}$ for the ratio of the intensities of the $2 \leftarrow 0$ and $1 \leftarrow 0$ bands of HCl agrees within the limits of experimental error with the observed value of $1 \cdot 61 \times 10^{-2}$. J. E. K.

3521. Relation Between Molecular Spectra and Atomic Rings of Electrons of Atoms. H. Deslandres. *Comptes Rendus*, 200. *pp.* 1997–2001, *June* 12, 1935.—A continuation of earlier work [see Abstract 2130 (1935)]. The molecules CO, COS, CH_3CONH_2, $COCl_2$, and C_2H_5COSH are considered. W. R. A.

3522. Characteristic Vibrations of Mechanical Molecular Models. Part II. Four-Mass Systems. F. Trenkler. *Phys. Zeits.* 36. *pp.* 423–432, *June* 15, 1935.—Using the type of mechanical model and resonance excitation previously described [see Abstract 1656 (1935)] the characteristic frequencies and forms of vibration of plane molecules with four masses are investigated. Reproductions are given of photographic records of the forms of vibration upon films moving at right angles to the direction of excitation. The following types of molecule are investigated: the axially symmetrical star-type (*e.g.*, phosgene), the centrally symmetrical star-type (*e.g.*, the carbonate ion), the cis- and trans-forms of the unbranched chain (*e.g.*, dichlorethylene) and the straight chain (*e.g.*, acetylene). The effects of variation of the valency angles and the masses are followed. In almost all cases the observed frequencies and vibrational forms are in agreement with the valency force theory, the discrepancies for the slow deformation frequencies being ascribed to the imperfections of the mechanical models. The degenerate vibrations of the centrally symmetrical star-type of molecule (*e.g.*, CO_3') are discussed in detail. Results upon models with more than four masses are promised in a further communication. L. A. W.

3523. Vibrations of Polyatomic Molecules in Excited Electronic States. A. B. F. Duncan. *J. Chem. Phys.* 3. *pp.* 384–385, *July*, 1935. —The vibration frequencies found in the excited states of the molecules CO_2, CS_2, H_2O, ClO_2, SO_2, O_3, NH_3, PCl_3, C_2H_2, C_2H_4, C_6H_6 and $(CH_3)_2CO$ are considered. The frequencies appearing most strongly in *all* cases, and in most cases the only frequencies occurring, are totally symmetrical. This is in accord with the extension of the Franck-Condon principle to such molecules by Herzberg and Teller. [See Abstract 3562 (1933).] AUTHOR.

3524. Energy Levels of the H_2 Spectrum. Part II. I. Sandeman. *Roy. Soc. Edinburgh, Proc.* 55. 1. *pp.* 49–61, 1935.—Having previously applied the methods of the older quantum theory to the H_2 spectrum [see Abstract 2518 (1934)], the author here discusses the validity of applying the results of the wave mechanics and the difficulties involved in the analysis. As far as the nature of the experimental problem allows, values of the structural constants for two electronic states, $1s\sigma\ 2s\sigma\ {}^3\Sigma^+_g$ and $1s\sigma\ 2p\sigma\ {}^1\Sigma^+_u$, which are the lower states for the strongest bands in the visible region, are calculated on the basis of Dunham's solution of the wave equation for a diatomic molecule, and empirical representations are given in the form of Dunham's energy expression $F_{vK} = \sum_{ij} Y_{ij}\,(v + \frac{1}{2})^i\, K^j\,(K + 1)^j$. Tables are given comparing the observed and calculated values of the rotational and vibrational term-differences for each of the two states. The consistency of the results indicates very little evidence of *l*-uncoupling.

Potential functions are obtained which indicate that Morse's function is not applicable to these states. W. J.

3525. Theory of $^3\Sigma^+ - {}^3\Sigma^-$ Transitions in Band Spectra. R. D. Present. *Phys. Rev.* 48. *pp.* 140–148, *July* 15, 1935.—Herzberg observed weak absorption bands of O_2 at λλ 2400–2600, consisting of *Q*-form ($\Delta K = 0$) branches only, and rightly attributed them to a "forbidden" transition $^3\Sigma^+_u \leftarrow {}^3\Sigma^-_g$. Two alternative explanations are (i) spin-orbit interaction and (ii) rotational distortion. In (i) no $\Delta K = \pm 1$ branches occur and the $\Delta K = \pm 2$ branches (numbering 12 in case *b* with resolved *J* structure) are only about one-fifth as strong as the $\Delta K = 0$ branches if the *J* structure is unresolved, and might well pass unnoticed in these faint bands. In (ii) only $\Delta K = 0$ branches occur. The intensities increase asymptotically with K in (i) and with K^3 in (ii). (i) is theoretically preferable from considerations of relative intensity, but further observations are necessary to decide between (i) and (ii). These bands should not be enhanced in O_4, and are thus in contrast to the Wulf-Finkelnburg-Steiner triple-headed bands of O_4 in the same region. The latter are due to $^3\Sigma^-_g + {}^3\Pi_g \leftarrow {}^3\Sigma_g + {}^3\Sigma_g$, the upper state having $^3\Pi_g$ instead of the $^3\Delta_u$ suggested by Finkelnburg. Transition $^1\Sigma^+ - {}^1\Sigma^-$ is impossible with (i), but occurs as a single *Q* branch with (ii). W. J.

3526. Ultra-Violet Fluorescence Spectrum of Iodine Vapour: the McLennan Bands. F. Duschinsky and P. Pringsheim. *Physica,* 2. *pp.* 633–644, *July,* 1935.—McLennan's diffuse ultra-violet fluorescence bands are investigated in regard to dependence on mode of excitation, vapour pressure and temperature. The lines used for excitation are Hg λ 1849, Al λλ 1855, 1863, Hg λ 1942, Zn λ 2062, Zn λ 2139, Cd λ 2265, Cd λ 2288, Hg λ 2537; wave-length and intensity data are tabulated for the bands observed in each case, and photometer curves are reproduced. Previous interpretations of the bands are discussed and shown to be inadequate. The bands are not entirely independent of the exciting wave-length; characteristic differences occur, although the groups of bands are the same in general appearance. No interpretation of the observations is given; they may possibly have to be reconsidered from an entirely new point of view. W. J.

3527. Zeeman Effect of the Absorption Lines of Crystalline $KCr(SO_4)_2 \cdot 12H_2O$. F. H. Spedding and G. C. Nutting. *J. Chem. Phys.* 3. *pp.* 369–375, *July,* 1935.—The Zeeman effect of the absorption lines at 20° Abs. shows three components, elliptically polarised and suggesting "spin only" orientation in the field (12000–25,000 gauss). The magnitude of a possible second-order Zeeman effect is $< 10\ \%$ of the first-order effect. Various coupling schemes are considered. W. R. A.

3528. Effect of Superimposed Electric and Magnetic Fields upon the Line Spectrum of Helium. W. Steubing. *Preuss. Akad. Wiss. Berlin, Ber.* 8. *pp.* 150–159, 1935.—He is chosen rather than H_2 because of the relative sharpness of the Stark effect components. Using the arrangement of Stark, experiments are carried out with and without a magnetic field superimposed upon the electric field. The spectra are photographed by means of a 3 m. concave grating giving a dispersion of 5·78 Å in the visible region investigated. The direction of observation is always normal to both fields, but two series of experiments are made: with the electric and magnetic fields (i) at right angles to each other and (ii) parallel to each other. In both cases the superposition of the magnetic field is observed to cause various changes in the positions and appearances of the lines. Specimen spectrograms are reproduced. L. A. W.

3529. Raman Spectrum of the Isomeric Nitro-Toluenes. R. M. Ansidei. *Accad. Lincei, Atti,* 21. *pp.* 581–584, *April* 28, 1935.—In view of certain differences in the results obtained by Kohlrausch, Dadieu and Jele, and by High in their studies of the Raman spectrum of *o*-, *m*- and *p*-nitro-toluene, the author has repeated these measurements and gives in a table his results and also those of the previous observers named. His measurements confirm those of Kohlrausch and his collaborators. In particular in the spectrum of *m*-nitro-toluene there are found the characteristic line about 990 cm.$^{-1}$, and the line of the group NO_2 at about 1520 cm.$^{-1}$ which are lacking in the spectra of High. J. J. S.

3530. Rotational Raman Scattering in Benzene at Different Temperatures. S. C. Sirkar and B. B. Maiti. *Indian Journ. Phys.* 9. *pp.* 323–330, *May,* 1935.—The rotational Raman scattering in benzene at room-temperature and at about 210° C. has been investigated with the help of a spectrograph producing lines absolutely free from coma on the Stokes sides. It has been found after quantitative measurement of the distribution of intensity in the wing that even at room-temperature the rotational wing does not start with maximum intensity at the centre of the Rayleigh line as reported by previous observers, but it starts with zero intensity at the said point, and after having a maximum intensity at about 18 wave numbers from the Rayleigh line, gradually diminishes in intensity and extends up to about 120 wave numbers. When the liquid is heated up to 210° C., the position of the maximum intensity shifts away from the Rayleigh line by about 5 wave numbers and also the wing becomes narrower and extends only up to 100 wave numbers from the Rayleigh line. AUTHORS.

3531. Raman Spectra of Metallic Halides. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 1*A. pp.* 850–858, *May,* 1935.—All the halides of Cd and the chloride and bromide of Zn have yielded lines which show the existence of homopolar binding. The spectra of $ZnCl_2$ and CdI_2 were fairly intense and indicate a linear triatomic model for them analogous to those of mercuric halides. Marked differences in intensity, sharpness and frequency have been observed in $ZnCl_2$, $CdBr_2$ and CdI_2, from crystal to solution and with different solvents. The presence of halogen ions in solution also affect the spectra considerably. These are explained partly by the change in the degree of ionisation in different solvents and partly by the influence of the solvent molecule on the fundamental oscillation frequencies of these compounds. The data obtained for the Cd halides do not furnish sufficient evidence for the formation of complex ions of the type CdX_4'' in solution. $McCl_2$, $MgBr_2$ and $AlCl_3$ gave no Raman lines. A pronounced effect on the bands of water was noticed in each case. AUTHOR.

3532. Raman Spectra of Dekahydro- and Tetrahydro-Naphthalene. S. K. Mukerji. *Phil. Mag.* 19. *pp.* 1079–1097, *June,* 1935.—The Raman spectra of the above have been recorded, using light filtered with quinine sulphate and m-dinitro-benzene so as to isolate λ 4358. A number of new lines are recorded, and the spectra compared with those due to cyclohexane and naphthalene. A. C. M.

3533. Raman Spectrum of Heavy Chloroform. R. W. Wood and D. H. Rank. *Phys. Rev.* 48. *pp.* 63–65, *July* 1, 1935.—The Raman spectrum of chloroform made from deuterium has been photographed and the line shifts measured. The three types of isotope effects observed in the spectrum of heavy chloroform have been discussed. By treating different groups of atoms in the molecule as entities satisfactory agreement between calculated and observed values for the isotope displacements can be secured. Some idea of the nature of the rôle played by the chlorines in the C–H "bending" and "stretching" vibrations is obtained. AUTHORS.

***3534. Spectrograph With Objective-Prism. L. and R. Herman.** *Rev. d'Optique*, 14. *pp.* 203–207, *May*, 1935.—A spectrograph without collimator is described in which the only optical elements are a quartz cornu prism and a concave mirror sputtered with Pt. It is useful for sources which subtend only a small angle, and the astigmatism of the inclined mirror is used to give some length to the spectrum lines. F. S.

3535. Quantitative Flame-Spectrum Analysis. F. Waibel. *Wiss. Veröff. a.d. Simens-Werken*, 14. 2. *pp.* 32–40, 1935.—Improvements in the technique of quantitative flame-spectrum analysis are described. Details are given of suitable atomisers requiring only small amounts of the solutions investigated and types of burner for different flame gases are discussed. The use of flint glass prisms is recommended in order to reduce the disturbing effect of the continuous background of the spectra. In addition to the alkali and alkaline earth metals the method is suitable for the determination of Fe, Mn, Cr, Ni, Co, Cu, Ag, Pb, Tl, etc. A neutral grey step wedge is used to obtain the intensity marks for the evaluation of the spectra. Several spectrograms are reproduced in order to show the advantages of the technique and its application to the analysis of alloys, minerals, water, etc. L. A. W.

See also Abstracts 3208, 3246, 3257, 3353, 3383, 3417, 3437, 3466, 3473, 3550, 3571, 3580, 3597.

VELOCITY OF LIGHT.

3536. Velocity of Light in a Partial Vacuum. A. A. Michelson, F. G. Pease and F. Pearson. *Mt. Wilson Observat., Contrib. No.* 522. *Astrophys. J.* 82. *pp.* 26–61, *July*, 1935.—The observations were made by the rotating-mirror method, the light passing through a steel tube 1 mile long, evacuated to pressures which ranged from 0·5 to 5·5 mm. mercury. By multiple reflections the path length was increased to 8 or 10 miles. The distance was obtained by reference to a carefully measured base line adjoining the tube. The time was measured stroboscopically through successive steps by use of a tuning fork synchronised with the rotating mirror, a free swinging pendulum, a chronometer, and wireless signals from Arlington. There were made 2885·5 determinations of the velocity, the simple mean value of which is 299,774 km./sec., with an average deviation of 11 km./sec. from the mean.

Series	Date	No. Separate Determinations	Mean Velocity	A.D.
1– 54	1931 Feb. 19–July 14	493	299,770	±12
55–110	1932 Mar. 3–May 13	753·5	299,780	11
111–158	1932 May 13–Aug. 4	742	299,771	9
159–233	1932 Dec. 3–1933 Feb. 27	897	299,775	±11
		2885·5	299,774	±11

AUTHORS.

3537. Standard Invariance and Velocity of Light. H. Jehle. *Zeits. f. Physik*, 95. 3–4. *pp.* 243–245, *June* 4, 1935.—A more or less known conception of the standard invariance principle with respect to dimensions is discussed, and from it a conclusion is drawn with respect to the problem of the constancy of the velocity of light. H. H. Ho.

VISION.

See Abstract 3434.

X-RAYS.

***3538. Needle Valve for Gas X-Ray Tubes. H. Kersten.** *Rev. Sci. Instruments*, 6. *p.* 175, *June*, 1935.—The valve consists of a choking needle working in a cylindrical orifice and operated by the differential action of a right-handed screw having 30 threads to the in. and a left-handed screw having 31 threads to the in., so that one complete revolution of the handle moves the needle about 0·001 in. In use the whole needle is moved by other screws to be roughly correct, and the differential motion is only employed for fine adjustment. The valve is well adapted to allow the passage of gas other than air. G. E. B.

3539. Relative Ionisation of the Heavy Inert Gases and of N_2, O_2, Air, CO_2, CH_4, C_2H_4, C_2H_2 and Propane. O. Gaertner. *Ann. d. Physik*, 23. 3. *pp.* 255–258, *June*, 1935.—Measurements were made of the relative ionisation with the Kα-line of Cu, with improvements in the method previously employed [see Abstracts 2456 (1933) and 1175 (1935)], and a table of results is given. Theory is not discussed but comparison is made with the results obtained by other observers. J. J. S.

3540. Relationship Between Blackening of a Photographic Emulsion and Its Exposure to X-Rays. J. E. de Langhe. *Zeits. f. wiss. Phot.* 34. *pp.* 174–180, *July*, 1935.—A relationship between blackening of a photographic emulsion and its exposure to X-rays proposed by Hofer [see Abstract 770 (1935)] is criticised, and a general expression for the blackening is deduced on the basis of certain hypotheses. It is concluded that (i) in the earlier stages the blackening is linear, and for a monodisperse film is proportional to the individual as well as to the total grain surface, whilst it is also a function of the wave-length; and (ii) the maximum tangent to the logarithmic blackening curve is independent of the wave-length of the irradiating X-rays. C. B. A.

***3541. Spectroscopy of Ultra-Soft X-Rays. Part IV. M. Siegbahn and T. Magnusson.** *Zeits. f. Physik*, 95. 3–4. *pp.* 133–157, *June* 4, 1935.—In continuation of previous work, results of measurements in the L-series of the elements Co 27 to Cl 17 are discussed. The Cl spectrum is particularly interesting, since some of its compounds give rise to displaced lines. An account is given of the modified X-ray spectrometer and of the gratings and the new ruling machine. [For Part III see Abstract 2927 (1934).] C. B. A.

3542. Intensity of the X-Ray Lines of Gold. L. Pincherle. *Physica*, 2. *pp.* 597–605, *July*, 1935.—A discussion is given of the different causes which influence the relative intensities of the X-ray lines, *viz.*, (1) the excitation functions, (2) the probabilities of the disappearance through transitions without radiation, and (3) the transition probabilities. As an example of these influences the case of the L lines of Au is chosen, and calculations are given which are in satisfactory agreement with experiment. J. J. S.

3543. Direct and Fluorescence Excitation of the K-Level in Thick Targets of Gold. K. B. Stoddard. *Phys. Rev.* 48. *pp.* 43–46, *July* 1, 1935.—The ratio P of the number of Kα-line quanta produced by direct kathode electron impact to the number of quanta produced by fluorescence as observed in the radiation from a thick gold target, is measured with normally emergent X-rays over a range of voltage extending from 1·3 to 2·2 times the K-excitation voltage. P is found to vary from 0·195 at $U = 1{\cdot}3$ to 0·27 at $U = 2{\cdot}2$, where U is the ratio of tube voltage to K-excitation voltage. The ratio Q of the probability of a kathode electron ionising the K-shell directly to the probability of a kathode electron exciting a continuous quantum of frequency greater than the K-limit frequency is found to vary from 0·07 at $U = 1{\cdot}3$ to 0·11 at $U = 2{\cdot}2$. A discussion of the variation of P with atomic number found experimentally and that to be expected theoretically is given, still indicating a lack of agreement between theory and experiment. [See Abstract 5092 (1934).] AUTHOR.

3544. Fine Structure of X-Ray Absorption Edges in Close-Packed Cubic and Hexagonal Crystal Lattices. D. Coster. *Physica,* 2. *pp.* 606–610, *July,* 1935.—It is pointed out that the cubic and the hexagonal close-packed crystal lattices give the same fine structure of X-ray absorption edges as regards the position of the maxima and minima relative to the main edge. As regards the form of the maxima and minima some typical differences between the fine structure of these two lattices still remain. AUTHOR.

3545. Shapes and Wave-Lengths of K-Series Lines of Elements Ti 22 to Ge 32. J. A. Bearden and C. H. Shaw. *Phys. Rev.* 48. *pp.* 18–30, *July* 1, 1935.—A double crystal spectrometer was used to measure the widths at half-maximum and the indices of asymmetry of the principle K-series lines of the elements Ti 22 to Ge 32. When sufficient intensity was available, measurements were made in three orders of diffraction, namely, in the $(1-2)$, $(1+1)$ and $(1+2)$ positions. Curves of width *vs.* atomic number and degree of asymmetry *vs.* atomic number are different in the various orders. These differences are discussed. Measurements were also made of the widths of certain satellites and of their intensities and displacements relative to an adjacent line. The diffraction angles of the peaks of the lines were determined with precision in two orders and wave-lengths calculated. Comparisons are made with single crystal photographic spectrometer work and the higher degree of accuracy obtained in the present work is pointed out. AUTHORS.

3546. Intensities of Satellites of Kα. Anna W. Pearsall. *Phys. Rev.* 48. *pp.* 133–135, *July* 15, 1935.—By use of a Siegbahn vacuum spectrograph, the intensities relative to that of the parent line, were measured for the satellites of the Kα_1-line for elements in the atomic number range 16–29; but these intensities are in general much lower than those reported for the satellites of the line Lβ_2. The variation in this range is from approximately 0·7 to about 5 %, while the maximum found for the satellites of Lβ_2 was 52 %. These results are in agreement with the prediction of Coster and Kronig as to low intensities for Kα-satellites; but, contrary to the Coster–Kronig theory, a possibility of a maximum of intensity is found which could not be explained on their assumption that the satellites originate in an Auger effect. AUTHOR.

See also **Abstracts 3429, 3466, 3675, 3679.**

HEAT.

CALORIMETRY.

***3547. Rotational Heat of Ortho-Deuterium. K. Clusius and E. Bartholomé.** *Zeits. f. phys. Chem.* 29. *Abt.B.* 3. *pp.* 162–169, 1935.—Rotational specific heats of HD between 35° and 68° Abs. and of D_2 between 35° and 118° Abs. are tabulated. An account of an apparatus for the preparation of ortho-deuterium is given, and the results of measurements of the rotational heat of this gas between 35° and 106° Abs. are described and discussed. C. B. A.

3548. Thermal Properties of Deuterium Oxide. R. S. Brown, W. H. Barnes and O. Maass. *Canad. J. of Research,* 12. *pp.* 699–701, *May,* 1935.—Values for the heat capacities of solid D_2O and the resulting liquid, from initial temperatures between 4° C. and $-78 \cdot 5°$ C. to a final temperature of 25·0° C., have been determined. The specific heats of the solid over the temperature range 0 to $-70°$ C. have been measured. The latent heat of fusion of D_2O has been determined. The specific heat of liquid D_2O is shown to be greater than that of water in the temperature region in which measurements were made. A comparison of the thermal properties of D_2O with those of H_2O has been made, and certain points of interest are indicated. AUTHORS.

3549. Heat Capacities of Gelatin Gels. W. R. Horn and J. H. Mennie. *Canad. J. of Research,* 12. *pp.* 702–706, *May,* 1935.—The heat required to warm a gelatin gel from 0° to 25° C. is greater than the sum of the heat capacities of the water and the gelatin present by an amount which varies with the concentration of the gel, and which equals 6·7 cal. per gm. of dry gelatin for gels of concentration below about 52 %. It is inferred that there is less bound water, or the water is less firmly bound, at 25° than it is at 0° C. If the heat capacity measurements are plotted against gel concentration, there is a sharp discontinuity at 0·52 gm. water per gm. of dry gelatin, which is interpreted as meaning that this is the amount of water which is closely bound at 0° C. AUTHORS.

3550. Heat Capacity and Vapour Pressure of Solid and Liquid Nitrous Oxide. Entropy from Band Spectrum. R. W. Blue and W. F. Giauque. *Am. Chem. Soc., J.* 57. *pp.* 991–997, *June,* 1935.—The heat capacities of solid and liquid N_2O are determined over their respective ranges from 14° Abs. to the boiling point 184·59° Abs., the melting point being 182·26° Abs. The heat of fusion is 1563 cal. per mole and the heat of vaporisation at the boiling point is 3958 cal. per mole. The vapour pressures of the solid and liquid are measured and expressions for their dependence upon temperature from 148·48 to 185·85° Abs. are given. The molal entropy of the gas at the boiling point, as calculated from the experimental data, comes out to 47·36 units ($\pm 0 \cdot 1$), which is 1·14 units less than the value calculated from spectroscopic data. This result indicates that the linear NNO molecule enters its crystal lattice without much discrimination between its ends. The molal entropy of nitrous oxide at 298·1° Abs. and 1 atmosphere is derived from band-spectrum data and found to be 52·581 units without nuclear spin entropy, the absolute value being 56·947. L. A. W.

3551. Heat Capacity of KCl from 2·3 to 17° K. W. H. Keesom and C. W. Clark. *K. Onnes Lab., Leiden, Comm. No.* 238*c. Physica,* 2. *pp.* 698–706, *July,* 1935.—The heat capacity of KCl was measured from 2·3—17° K. When the results are considered in the light of the Debye theory of specific heats, the parameter Θ does not remain constant. The value of Θ rises from about 220 at 10° K. to 236 at 4·5° K. and then diminishes toward lower temperatures. Because of the possibility of a desorption heat connected with the helium gas present in the calorimeter for heat conductivity, the interpretation of the results below 4·2° K. is somewhat uncertain. The Θ, T-curve for KCl does not show the steep descent exhibited by that of Ag in the liquid helium range, but the Θ T-curve for Ag corrected for the heat capacity expected for 1 free electron per atom, is very similar to that found for KCl. We consider this fact as a corroboration of the hypothesis that the steep descent shown by the Θ, T-curve of Ag is due to the heat capacity of the free electrons.
AUTHORS.

See also Abstracts **3414, 3626.**

CONDUCTION.

3552. Limacoidal Heat Conductivity Distribution Function. W. S. Kimball. *Phil. Mag.* 20. *pp.* 97–128, *July,* 1935.—Distribution functions for viscosity and heat conduction have been derived by Chapman and Enskog using successive approximations in solving the transport equation and Boltzmann's equation. When Newtonian mechanics and elasticity theory are relied upon according to the geometrical weight method the heat conductivity distribution function for the uniform pressure case takes the form :—

$$f = 1/\alpha^3 b\pi^{3/2}(1 + \sigma \cos \theta)^4 \, exp. \, (-c^2/\alpha^2(1 + \sigma \cos \theta)^2)$$

where the temperature is given in terms of α by the familiar $kT = m\alpha^2/2$, and b is related to the impact strain " a " according to an equation, whereas σ is a variable strain that obtains between impacts. This distribution is limacoidal in that the exponents when set equal to the constants $-c'^2/\alpha^2$ are loci of heterogeneous strain in velocity space. The conclusions all rest on Newtonian mechanics and elasticity theory and probability is incidental. The case of an ideal gas at uniform pressure is treated in the present case. The accuracy is of the same order as the gas law and Maxwell's velocity distribution. The present distribution is an exact solution of Boltzmann's continuity equation. Theoretical discussion is followed by a full summary. S. G. B.

3553. Thermal Conductivity of Quartz at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. No.* 236*c. Physica,* 2. *pp.* 673–682, *July,* 1935.—The thermal conductivity of quartz // to the axis has been investigated as well as the influence of heat treatment on the conductivity. The former shows a strong decrease at very low temperatures. AUTHORS.

3554. Energy Exchange between Ne-, A- and Hg-Atoms and a Solid Wall. A. A. Zaicev and G. V. Spivak. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 118–125, *April* 11, 1935. *In German.*—The present work is a study on the accommodation coefficient, which can vary between 0 and 1, for the energy exchange between gas atoms and a solid wall. It is shown that the coefficient for A is roughly twice that for Ne and that the coefficient for A and Ne depends on an adsorption film. J. K.

CONVECTION.

3555. Natural Convection from Wires : Existence of a New Law of Convection. C. Bory. *Comptes Rendus,* 200. *pp.* 1918–1919, *June* 3, 1935.—The dependence of the natural convection from fine wires on the diameter of the wire is studied. It is found that the accepted law for large diameters no longer holds for wires ranging from 0·025 to 0·077 mm. in dia. In addition when the finest wire tested is maintained at temperatures of only 24° C. and 46° C. above the surroundings the heat loss no longer follows the normal curve obtained for greater excess temperatures. The results are considered to indicate the existence of two distinct laws of convection. [See also following Abstract.] R. W. P.

3556. Laws of Convection. P. Vernotte. *Comptes Rendus,* 200. *pp.* 1919–1921, *June* 3, 1935.—In connection with the foregoing paper [see preceding Abstract] data are given to show that the product of the heat loss by natural convection and the square root of the diameter of the wire remains sensibly constant for diameters ranging from 0·042 to 58 mm. Reference is made to earlier work using an ellipsoid in which a different law of convection had been found to hold for small excess temperatures. It is pointed out that a straight line through Bory's two points which depart from the normal curve intercepts the ordinate for zero diameter at a value equal to the heat loss due to conduction alone. It is suggested that the two kinds of convection can be correlated with changes in the nature of the air movement over the heated surface. R. W. P.

DILATATION.

3557. Coefficient of Expansion of Deuterium. J. B. M. Coppock. *Faraday Soc., Trans.* 31. *pp.* 913–914, *July,* 1935.—The mean value found for deuterium is about 1 part in 6000 less than that assigned to hydrogen : such a difference is within the limits of experimental error. It may be concluded therefore that the coefficients at constant pressure and constant volume for the two isotopes are identical. AUTHOR.

See also Abstract 3614.

MELTING AND BOILING POINTS.

3558. Melting Points of Ca, Sr and Ba. F. Hoffmann and A. Schulze. *Phys. Zeits.* 36. *pp.* 453–458, *July* 1, 1935. *From the Reichsanstalt. Zeits. f. Metallkunde,* 27. *pp.* 155–158, *July,* 1935.—Previous determinations of the melting points of the alkaline earth metals are tabulated. In the case of Ca they vary between 760 and 851° C. ; in the case of Sr and Ba an even greater range is observed. The authors take great care to prepare pure specimens of the elements, the melting points of which are determined by observing the arrest points on the heating and cooling curves using a AuPdPt-PtRh thermocouple. The following melting points are given : Ca 851° C. ; Sr 771° C. ; Ba 704° C. (to within ± 1° C.). These values show a steady decrease as the atomic volume increases which is in agreement with periodic table predictions. H. J. H. S.

See also Abstract 3547.

TEMPERATURE, MEASUREMENT OF.

See Abstract 3398.

THERMOCHEMISTRY.

3559. Heats of Dilution and Osmotic Pressures of Solutions of Non-Electrolytes. C. Frenzel, R. Burian and O. Haas. *Zeits. Elektrochem.* 41. *pp.* 419–429, *July*, 1935.—The specific heats of solutions of cane sugar, grape sugar and urea were determined over a considerable range of concentrations and temperatures. The accuracy was of the order of $\pm 0 \cdot 1$ %. From these results the temperature coefficients of the molar differential heats of dilution were calculated. It was shown that by the neglect of the heat of dilution in calculating the osmotic pressure of cane sugar solutions from the equation $\pi = -\mathrm{RT}/v \log (\mathrm{I} - \mathrm{X})$, an erroneous result was obtained, which differed from the observed results by 10 %. F. J. B.

3560. Heat Exchange in Metallic Transformations. H. v. Steinwehr and A. Schulze. *Phys. Zeits.* 36. *pp.* 419–423, *June* 15, 1935. *From the Reichsanstalt. Zeits. f. Metallkunde*, 27. *pp.* 129–132, *June*, 1935.—Previous work on metallic transformations [see Abstract 3104 (1935)] is extended to the case of iron of 99·97 % purity. Using the same method as already described, it is found that the heat given out in the magnetic (A_2) transformation occurring over the range 710 to 790° C. is 4·8 cal./gm. (mean error ± 0·2 cal./gm.) and in the allotropic (A_3) transformation occurring between 870 and 894° C. 6·2 cal./gm. (mean error ± 0·08 cal./gm.). H. J. H. S.

3561. Electronic State of the Carbon Atom and Calculation of Bond Energies. W. Lasareff. *Physica*, 2. *pp.* 737–742, *July*, 1935.—The recent value for the difference of energy of the states $C(^3P)$ and $C(^5S)$, $\Delta E = 4 \cdot 2 \pm 0 \cdot 2$ v.e. (*c.f.* Edlén, Bacher and Goudsmit) enables, in certain cases, the determination of the dissociation scheme for carbon compounds and involves a revision of the bond energies recorded for $C(^5S)$. Examples: (1) The molecule CN, in its lower electronic state $X^2\Sigma$, is dissociated into $C(^3P) + N(^4S)$; (2) The energy of the carbon-carbon bond in diamond is 132 ± 3·5 k.cal. = 5·73 ± 0·15 v.e., whence (E_{c-c}) aliphatic = 128 k.cal. = 5·56 v.e. H. H. Ho.

3562. Flame Temperatures and Explosion Pressures. B. Lewis and G. v. Elbe. *Phil. Mag.* 20. *pp.* 44–65, *July*, 1935.—Theoretical flame temperatures and explosion pressures are calculated accurately with the aid of exact spectroscopic data on specific heats and thermal dissociation, and in the present work the agreement between the two values is very good. In some cases experimental values are somewhat higher and in other cases lower than theoretical values. These anomalies are discussed in the light of various factors such as dependence on specific heats and radiation losses. A method is appended for rigid calculation of theoretical flame temperatures. It is shown that the objections of David and his co-workers to the line-reversal method of measuring flame temperatures are invalid [see following Abstract]. Their results from the unheated wire method are criticised as being at variance with the results of the electrically heated wire method, the electric conductivity method and the radiometric method. Their estimated radiation losses from the wire are not in agreement with those of Hopkinson. The conception of "afterburning" or "latent energy," *i.e.*, the existence of abnormal molecules of great stability in the flame gas carrying large amounts of energy, is at variance with known relative facts as to flame temperatures and explosion pressures and is not supported by the results of experiment. S. G. B.

3563. Flame Temperatures and Explosion Pressures. W. T. David. *Phil. Mag.* 20. *pp.* 65–68, *July*, 1935.—In reply to Lewis and v. Elbe [see preceding Abstract], the author points out that the latter concern themselves mainly with the proof that actual flame temperatures are equal to ideal calculated temperatures and that therefore flame gases cannot hold within them large amounts of latent energy. Two generalisations are the basis of this contention: (1) flame temperatures as measured by the sodium line-reversal method are equal to the calculated temperatures, and (2) flame temperatures as measured by the sodium method are correct because they agree with those obtained by other methods. These generalisations are easily shown to be in error and the deductions incorrect. A comprehensive examination of sodium measurements recorded in scientific literature shows that calculated temperatures and sodium-flame temperatures bear no obvious relationship to each other. The second of their generalisations was made and based upon an inadequate range of observations. Comparisons between measurements made by the sodium method and the electrically heated wire method were made for single mixture strengths only and not over a wide range of conditions. The size of the explosion vessels is criticised and the results of more recent experiments of David, Brown and El Din quoted in support of the author's contentions. S. G. B.

3564. Statistical Mechanical Treatment of the Activated Complex in Chemical Reactions. L. S. Kassel. *J. Chem. Phys.* 3 *pp.* 399–400, *July*, 1935.—A possible error in Eyring's recent calculations of absolute reaction rates [see Abstract 1206 (1935)] due to the short life and consequent unsharp quantisation of the activated complex is noted. The existence of this error is made more probable by a consideration of the target area required by Eyring's equations at low temperatures. There is no doubt that his treatment becomes asymptotically correct at high temperatures. AUTHOR.

See also Abstract 3399.

THERMODYNAMICS.

3565. Near and Far Action in the Thermodynamical Equation of State. W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 4–13, *Jan.–Feb.*, 1935. *In English.*—The author has recently considered [see Abstracts 2186 and 2188 (1935)] the C_v- and C_p-methods used in the thermodynamical theory of the equation of state, his theory differing from the classical van der Waals theory by the selection theorem and by the conditions with the help of which the thermodynamical perfection of any equation of state can be estimated. The present paper attempts to analyse the two methods in connection with the conceptions of the classical cohesive (mechanical) or *far* actions and the modern collision (calorical) or *near* action of the internal constitution of bodies; it is entirely mathematical. [See following Abstract.] H. H. Ho.

3566. Principle of Dominant-Action in the Thermodynamical Equation of State. W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 14–19, *Jan.–Feb.*, 1935. *In English.*—It is shown that the real gas-deviations of real gases from the Clapeyron system cannot be determined with the help of the far-action [see preceding Abstract] Γ_v $(= \partial f(v)/\partial v)$, but for their computation require not only the near-action Γ $(= -Apv_{-a})$ but also the calorical $C(\Gamma)$ $\left(= \int_0^v \left(\frac{\partial C_v}{\partial v}\right)_t d\psi\right)$ and dominant

$C(\Gamma_v)\ [=(\partial\Phi(t_1v)/\partial v)t]$, which must be considered from the standpoint of the new thermodynamical theory of state. H. H. Ho.

3567. Properties of Real Gases Based on the Thermodynamical Equation of State. Part V. Compressibility of He below the Critical State in the Interval from 4·34°K. to 2·59°K. W. Jacyna. *Zeits. f. Physik*, 95. 3–4. *pp.* 246–251, *June* 4, 1935.—By means of the thermodynamical equation of state $vp = R\psi + pf(t.p)$, the calculations of the He-isotherms from the experimental data of K. Onnes and Boks below 5° K., are confirmed by the recent investigations of Keesom and Kraak. The results are discussed and compared by tabular and graphical illustrations. [For Part IV see Abstract 1733 (1935).] H. H. Ho.

3568. Properties of Real Gases Based on the Thermodynamical Equation of State. Part VI. Critical Region of Helium. W. Jacyna. *Zeits. f. Physik*, 95. 3–4. *pp.* 253–261, *June* 4, 1935.—By means of the conventional critical parameter values, $p_k = 2 \cdot 34 \cdot 10^4$ kg./m.^{2} $\psi_k = 5 \cdot 32°$ K. ($\psi_0 = 273 \cdot 22°$ K.) introduced into the thermodynamical equation of state, the critical coefficient for He has been calculated as 3·18 and the critical volume as $0 \cdot 0151_5$ m.^{3}/kg. The critical region in the $(p.t)$-diagram has an elliptical form with the major axis $\Delta p = 0 \cdot 0344$ (atmosphere) and $2\Delta t = 0 \cdot 0808$ (°C.). The results are discussed from the experimental standpoint with reference to the data compiled for SO_2, CO_2, CCl_4, etc., by Hein, K. Onnes, Fabius, Bradley, etc., and are illustrated in both tabular and graphical form. [See preceding Abstract.] H. H. Ho.

3569. Properties of Real Gases Based on the Thermodynamical Equation of State. Part VII. Boyle-Region for Helium. W. Jacyna. *Zeits. f. Physik*. 95. 5–6. *pp.* 409–414, *June* 17, 1935.—The position of "Amagat's minima" (the Boyle-line) has the character of an explosion-line determined by the general equation $e^{-\eta} - p(\partial\eta/\partial p)_t - 1 = 0$. In the Amagat diagram, the latter coincides either with the basis line for temperature increase, or with the vp-axis for temperature decrease. The classical Boyle-temperature for helium should be anticipated between the limits 25–35° K. (instead of 18–22° K.). Naturally, in the new theory, the idea of the Boyle-temperature is regarded as purely conventional, and can only be taken as a first approximation to the true relationships. The conclusions are given in the paper both in tabular and graphical form. [See preceding Abstract.] H. H. Ho.

3570. ψ_0-Value from the New Equation of State. W. Jacyna. *Zeits. f. Physik*, 95. 3–4. *p.* 252. *June* 4, 1935.—The ψ_0 value now computed, *viz.*, 273·22° K. only differs from the earlier value $273 \cdot 21°_5$ K. [see Abstract 1732 (1935)] by $0 \cdot 005°_5$ K. H. H. Ho.

3571. Molecular Heat-Capacity Equation of Sulphur Vapour. I. N. Godnev. *Phys. Zeits. d. Sowjetunion*, 7. 4. *pp.* 442–446, 1935. *In English.*—The calculation of molecular heat of S_2 from spectroscopic vibration frequency is discussed. Two equations are derived to fit the theoretical molecular heat curve from 300° K. to 1300° K. AUTHOR.

3572. Rotational Entropy of Non-Rigid Polyatomic Molecules. M. L. Eidinoff and J. G. Aston. *J. Chem. Phys.* 3. *pp.* 379–383, *July*, 1935.—An expression is derived for the rotational entropy of non-rigid polyatomic molecules with zero potential and apart from nuclear spin and symmetry-number corrections. Previous empirical formulæ are derived as special simplified cases of the general formula. Applications are made to several important types of molecular models. AUTHORS.

3573. Thermodynamic Theory of Detonation. R. L. Scorah. *J. Chem. Phys.* 3. *pp.* 425–430, *July*, 1935.—From a consideration of the detonation wave, the author concludes that the detonation velocity is a physical constant of the particular explosive gas mixture and as such should be amenable to thermodynamic analysis. Theories of the detonation wave are next briefly discussed and the Hugoniot relations, which admit velocities ranging from a certain minimum to infinity, are examined at length. Jouguet's relations, which were obtained from Hugoniot's are derived by the present author in a somewhat different way. The available energy of steady flow as studied by Willard Gibbs, Darrieus, Keenan, etc., is next considered and is followed by an application to the measurement of the decrease of available energy suffered by gases as they stream through the wave. It is found that the normal detonation wave proceeds at that speed which allows the greatest degradation of each unit of energy supplied to the wave. This principle not only explains the success of Chapman's outright assumption and of Jouguet's physical postulate, but also provides a fundamental starting point from which to derive such stability relations. Data are included. H. H. Ho.

3574. Energy Loss in Combustion. J. Villey. *Comptes Rendus*, 200. *pp.* 1921–1923, *June* 3, 1935.—The problem is to evaluate the irreversible increase of entropy during combustion. The author takes the case of constant volume and diatomic gases, and considers together the thermodynamical diagrams for initial mixture of gases, final state, and transitional stage, and sets up a theoretical reversible combustion. Heat is taken in from atmospheric temperature to that of thermal dissociation of the two gases and given out at temperatures down to the temperature of combustion. The resulting formulæ show clearly the nature of the energy loss. T. L. M.

3575. Intensity Parameter and Stable Thermodynamical Equilibrium. T. Ehrenfest-Afanassjewa and G. L. de Haas-Lorentz. *Physica*, 2. *pp.* 743–752, *July*, 1935.—In this paper a precise definition of the idea " intensity parameter " is proposed [see Abstract 2573 (1934)] which appears to be the most suitable for application of the le Chatelier–Braun principle, and the true basis is established for the reason why the differential coefficients of this type of parameter with respect to the appropriate variables must always be positive. In connection therewith, the idea of a stable thermodynamical equilibrium is discussed.

H. H. Ho.

See also Abstracts 3286, 3466, 3550.

VAPOUR PRESSURE.

3576. Vapour Pressure of Neon at Liquid Hydrogen Temperatures. W. H. Keesom and J. Haantjes. *K. Onnes Lab., Leiden. Comm. No.* 235*c*. *Physica*, 2. *pp.* 460–462, *May*, 1935.—*In English.* Vapour pressure measurements of neon were carried out between 15° K. and 20·4° K. The results are in accordance with the theoretical vapour pressure formula for a monatomic substance if the chemical constant is given its theoretical value. AUTHORS.

3577. Vapour Pressure of Solid Krypton. W. H. Keesom, J. Mazur and J. J. Meihuizen. *K. Onnes Lab., Leiden, Comm. No.* 238*a*. *Physica*, 2. *pp.* 669–672, *July*, 1935.—Vapour pressures of solid Kr have been measured from the triple-point to 78° K. The triple-point has been found to be $T = 115 \cdot 94°$ K., $p = 54 \cdot 9$ cm. The agreement with theory is satisfactory for pressures not too close to the triple-point. AUTHORS.

3578. Vapour Pressures of Ortho- and Para-Modifications of the Hydrogen Isotopes. K. Clusius. *Zeits. f. phys. Chem.* 29. *Abt.* B.3. *pp.* 159–161, 1935.—It is pointed out that the relative differences in the vapour pressures of the ortho- and para-modifications of the two isotopes of hydrogen are practically the same. This is interpreted as showing that in the one quantum rotation state of the molecule the interaction of the quadripole moments of neighbouring molecules is superposed on the dispersion effect, which gives rise to the molecular attraction in the zero quantum rotation state. C. B. A.

3579. Vapour Pressures of Isotopic Forms of Water. M. H. Wahl and H. C. Urey. *J. Chem. Phys.* 3. *pp.* 411–414, *July,* 1935.—The ratio of vapour pressures of H_2O^{16} and HDO^{16} and of H_2O^{16} and H_2O^{18} have been determined at four temperatures between $11 \cdot 25°$ C. and $46 \cdot 35°$ C. The ratio of vapour pressures of HDO^{16} are very nearly the geometric mean of the vapour pressure of H_2O^{16} and D_2O^{16}. The vapour pressure of H_2O^{18} varies from approximately $0 \cdot 8$ to $1 \cdot 2$ % less than the vapour pressures of H_2O^{16} for temperatures between $46 \cdot 35°$ C. and $11 \cdot 25°$ C. The application of these to the separation of the H and O isotopes by distillation is discussed. It seems possible that the H isotopes can be separated by the fractional distillation of water, but that the separation of the O isotopes by this method will be considerably more difficult. AUTHORS.

3580. Properties of HI and DI. J. R. Bates, J. O. Halford and L. C. Anderson. *J. Chem. Phys.* 3. *pp.* 415–420, *July,* 1935.—The absorption spectra and vapour pressures of HI and DI have been measured. The absorption of HI occurs at longer wave-lengths than that of DI. The vapour pressures are only slightly different, the DI having a greater value at a given temperature. The theoretical reasons for these differences are discussed, and equations for the vapour pressures are given as determined by this and other work. AUTHORS.

See also Abstracts 3328, 3384, 3550.

ACOUSTICS.

3581. Principle of Uncertainty in Sound. W. E. Kock. *Acoustical Soc. of America, J.* 7. *pp.* 56–58, *July,* 1935.—Following Stewart [see Abstract 1983 (1931)] a discussion of the application of the principle of uncertainty ($\Delta v \Delta t \approx 1$) to sound phenomena is given. Various sound phenomena are thereby explained and certain related experiments with frequency vibrato are reported. The phenomena explained are: The chromatic glissando imitation of a portamento, analysis of a formant into a Fourier series, the relation between vibrato wideness and pitch range and the pleasing effect of a frequency vibrato. AUTHOR.

3582. Dust Figures in a Kundt's Tube. R. B. Hastings and D. H. Ball. *Acoustical Soc. of America, J.* 7. *pp.* 59–63, *June,* 1935.—Very clear photographs of the particles in a striation were made by causing the striation to move out to the end of the tube and remain stationary long enough to be photographed. Photographs were also taken through the eyepiece of a microscope. From these it was evident that the particles in a striation did not, in general, touch each other. Striations on either side of a long metal rod on the bottom of the tube usually showed different spacings and occurred in different numbers on either side. This could not be caused by overtones since it is unlikely that more overtones could exist on one side than on the other. An electrostatic charge in motion near the tube prevented the figures from forming. A stationary charge in no way prevented their formation. AUTHORS.

3583. Tone Quality of Pianoforte. R. N. Ghosh. *Acoustical Soc. of America, J.* 7. *pp.* 27–28, *July,* 1935.—The writer's results confirm the view that there is no change of quality in the aerial vibrations without change of loudness [see Abstract 4638 (1934)]. Further, the vibration curve of the string is independent of the velocity of impact of the felt hammer, and the vibrations of the sound board are referred to as the cause of the changes in aerial tone quality. G. E. A.

3584. Velocity of Waves in Oil under Pressure. A. C. Talbott. *Phil. Mag.* 19. *pp.* 1126–1141, *June,* 1935.—The experimental part deals with the measurement of the bulk modulus of the oil, its viscosity under pressure, and the velocity of the wave through the oil. The bulk modulus for adiabatic compression at various pressures up to 6000 lb./sq.in. is graphed against temperature. There is only a small difference between the adiabatic and isothermal compressibilities of Diesel oil. The viscosity is also tabulated for various temperatures and pressures. The effect of viscosity reduces the velocity of the pressure wave by about 10 % in the extreme cases, and the pressure amplitude is damped at a greater rate. The graphs of the measured wave-velocities in oil show that the velocity increases with the pipe diameter and with the pressure, but diminishes with temperature increase. G. E. A.

***3585. Velocity of Sound in Low-Temperature Liquids at Ultrasonic Frequencies. A. Pitt and W. J. Jackson.** *Canad. J. of Research,* 12. *pp.* 686–689, *May,* 1935.—An ultrasonic interferometer apparatus has been developed for the measurement of the velocity of sound in low-temperature liquids. The method follows in general the conventional manner of producing sound waves in a liquid, *i.e.,* by the vibrations of a piezoelectric quartz plate driven at a high frequency.

The velocity of sound in liquid oxygen and hydrogen at an ultrasonic frequency of 427 kc. per sec. was found to be: oxygen, 912 m. per sec. (temp., $-182\cdot9^\circ$ C.); hydrogen, 1127 m. per sec. (temp., $-252\cdot7^\circ$ C.). AUTHORS.

3586. Velocity of H.F. Sound in Small Tubes. G. A. Norton. *Accoustical Soc. of America, J.* 7. *pp.* 16–26, *July*, 1935.—This study of the velocity of h.f. sound in small tubes covers the range of frequency from about 10 to 80 kc. per sec., and in dia. from 1/2″ to 3/16″. The method of G. W. Pierce, using magnetostriction oscillators, has been followed, providing high accuracy of measurement. Careful precautions in the construction were taken to eliminate the variations due to humidity, impurity, and to spurious reflections. The results tend to support definitely the Helmholtz-Kirchhoff reduction law, but provide a smaller observed value of the constant for pure air compared to the theoretical value. The value of freespace velocity derived from these experiments checks that independently obtained by Grabau, using a similar method in air, to within 1 part in 4000. Hence the present tube method may be applied to delicate measurements of sound dispersion in pure gases, and their mixtures. AUTHOR.

3587. Effect of Intensity on Supersonic Wave Velocity. W. H. Pielemeier. *Acoustical Soc. of America, J.* 7. *pp.* 37–38, *July*, 1935.—Further evidence is presented that supersonic waves in air have a velocity which depends on their intensity and that this velocity approaches the limiting value $(\gamma P/\rho)^{\frac{1}{2}}$ at comparatively low intensities. [See Abstract 526 (1932).] AUTHOR.

3588. Destructive Effects of Bubbles Liberated by the Passage of Intense Sound through a Liquid. F. D. Smith. *Phil. Mag.* 19. *pp.* 1147–1151, *June*, 1935.—When intense sound waves pass through a liquid gas-bubbles are released and grow. At one stage in their growth these show considerable activity and the author attributes this to their resonating to the incident sound. The resonant frequency is shown to be $(1/2\pi a)\sqrt{3\gamma(p_0 + 2\mathrm{T}/\mathrm{A})\rho}$, where a = bubble radius, p_0 = hydrostatic pressure, T = surface tension, ρ = density of liquid, γ = ratio of specific heats. It is suggested that the greater amplitude of vibration which would occur when such a bubble was in contact with a solid object might provide an explanation of the destructive properties. J. E. R. C.

3589. Reverberation in Two Adjacent Rooms. K. Yamashita. *Kyoto Coll. Sci., Mem.* 17. *pp.* 219–240, *July*, 1934.—Two cases are considered. The first is a case where the two rooms have the same acoustic properties and their walls are made up of a few kinds of material with large areas. Applying the method of Millington, the diffraction of sound is neglected and the number of incidences of sound-rays on each surface is treated statistically. The second case is that where the two adjacent rooms have different acoustic properties though their shapes and sizes are identical. In the latter case, assuming that the sound-waves are well diffracted, the simultaneous recurring equations for reverberation are obtained, and then by solving them the sound energies in the two rooms are found both when the source is sounding in one of the rooms and after it has been stopped. AUTHOR.

3590. Analysis of Vibrato. J. R. Tolmie. *Acoustical Soc. of America, J.* 7. *pp.* 29–36, *July*, 1935.—A preliminary treatment regards the vibrato as a frequency modulation only. Postulating that the fundamental frequency is much greater than either the modulation frequency or the amplitude of the modulation, simple analysis shows that the vibrato is equivalent to a spectral distribution of closely adjacent side tones. The more complicated case of simultaneous variation of frequency and of amplitude, the amplitude variation being either in or out of phase with the frequency variation, is also dealt with and the spectral distribution obtained. Possible uses of the results from the point of view of electrical musical instruments are pointed out. J. E. R. C.

3591. Sensitivity of the Ear. H. C. Montgomery. *Acoustical Soc. of America, J.* 7. *pp.* 39–43, *July,* 1935.—The lack of agreement among previous measurements of differential intensity sensitivity indicates that the values obtained depend to a large extent on the experimental conditions. The relative importance of various factors is indicated, and a procedure is suggested which was designed to give the smallest possible values of differential intensity sensitivity. Intensive measurements made by this method upon a single subject, using a pure tone of 1000 cycles gave values consistently smaller than any previously reported. There is no sharp division between intensity changes which can be perceived and those which cannot. The response of the subject is essentially variable and can only be described by statistical methods. AUTHOR.

3592. Beats and Combination Tones at Intervals Between the Unison and the Octave. J. C. Cotton. *Acoustical Soc. of America, J.* 7. *pp.* 44–50, *July,* 1935.—A valve apparatus was employed in exploring the region between the unison and the octave for beats. One tone of frequency 1000 was kept constant while another tone of approximately equal intensity was varied from 500 to 1000 cycles/sec. Subsequent analysis gave the intervals about which beats occurred. The results confirm Thomson's statement (1878) that beats may be heard at intervals other than the unison, octave and fifth observed by Helmholtz. Nineteen distinct beat regions were observed between the unison and the octave, besides a large number of fainter beat regions. The results are discussed from the point of view of the theories of the subjective tone and of the asinic wave. G. E. A.

***3593. Acoustical Instruments. E. C. Wente.** *Acoustical Soc. of America, J.* 7. *pp.* 1–15, *July,* 1935.—Previous to the development of amplifiers most of the instruments used in acoustical research depended for their operation upon purely mechanical principles. This paper includes a brief survey of such of these instruments as are still of interest in connection with the investigation of technical or research problems in acoustics, but it deals primarily with the more recent electrical devices used in the study of air-borne sound waves. The limitations and fields of application of various electrical instruments, including microphones, particularly adapted to definite types of acoustic measurements, are discussed. AUTHOR.

***3594. Precise Standard of Musical Pitch. H. W. Lamson.** *Acoustical Soc. of America, J.* 7. *pp.* 51–55, *July,* 1935.—A design of self-maintained tuning fork is described, the frequency of which is reliable to within one part in 10,000. It consists of a specially shaped fork, of calculable frequency, to each tine of which a small microphone button is attached. The one microphone is used to control the maintaining magnet while the other serves as a pickup to deliver a.c. of the the same frequency as the fork. The very considerable harmonic generated is removed by a suitable electrical network. The stroboscopic use of the instrument to set the frequencies of musical instruments is suggested. J. E. R. C.

See also Abstract 3699.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***3595. Capacity Measuring Bridge. E. E. Wright and G. E. G. Graham.** *Journ. Sci. Instruments*, 12. *pp.* 220–221, *July*, 1935.—A method of determining a capacity by means of a Post Office box and a ballistic galvanometer is described. AUTHORS.

3596. Avoidance of Errors Due to "Leads" in Radio-Frequency Measurements. R. M. Davies. *Phil. Mag.* 20. *pp.* 75–97, *July*, 1935.—In a number of practical cases it may be assumed that the distributed characteristics of the leads are constant at all points, in which case the leads may be regarded as a uniform transmission line with distributed characteristics and the theory of transmission lines will be applicable. Some results from this theory are first given and then the following cases are considered: leads terminated (1) by a resistance, (2) by an inductance, (3) by a capacitance, (4) by a variable condenser with a linear law, (5) by capacitance and resistance. For each of the above the conditions for making the effect of the leads as small as possible are stated. A. W.

CONDUCTION AND DISCHARGE IN GASES.

3597. Sparks from Flame Electrodes. M. Pierucci. *N. Cimento*, 12. *pp.* 240–242, *April*, 1935.—Using a Na-flame electrode, the nature of the spark emitted is examined as a function of the applied potential. With low potentials the spark is visible at the tip of the flame but the appearance depends on the conductivity of the flame. At higher potentials the discharge extends to and ultimately takes place entirely from the metal gas supply tube. If the flame is now vigorously stoked, brilliantly coloured discharges are produced. Spectroscopic examination shows a decrease in intensity as the base of the flame is approached, the prevalent lines being those of non-ionised atoms. The intensity of the *raies ultimes* is greatly increased and shows strong auto-inversion. F. C. C.

3598. Variation of Sparking Potential with Intense Ultra-Violet Illumination. H. J. White. *Phys. Rev.* 48. *pp.* 113–117, *July* 15, 1935. —The static sparking potential is lowered by illuminating the kathode of a spark gap with intense ultra-violet light. The reduced sparking potentials up to about 10 % in air were found to be a function of gas pressure times gap length and therefore obey Paschen's law. The approximate law for the amount of lowering of the sparking potential can be expressed by the condition that a certain number remains constant. This number is the number of positive ions generated by electron collision in the gas as the result of a given number of photoelectrons being liberated at the kathode by one flash of the illuminating spark. Thus the breakdown is a space-charge phenomenon and some fixed value of the field is necessary for breakdown to occur. Then if the distribution of the space charges does not change appreciably, the amount necessary to produce the given field will be constant. AUTHOR.

3599. Theory of the Non-Self-Maintained Flow of Electricity Through Gases. H. Mache. *E.u.M.* 53. *pp.* 253–258, *June* 2, *and pp.* 269–273, *June* 9, 1935.—The discussion here given is limited to the type of discharge not self-maintained, to field-strengths such that no ionisation by impact occurs and to gas densities high enough for the negative ions to be normal ions only. The ionic velocity can then be taken as proportional to the field strength, so that the specific ionic mobility is independent of the field-strength. The gas is also assumed stationary, necessitating, at least for weak fields, a high degree of temperature equilibrium. The discharge chamber is assumed large enough and the gas free from nuclei, so that the effect of adsorption in reducing the number of ions present may be neglected. Under these assumptions the differential equations are obtained and solved for certain simple cases. A. W.

3600. Relative Temperature and Pressure of the Gases in an Electric Arc. G. Righini. *Physica,* 2. *pp.* 585–590, *July,* 1935.—The temperature and pressure at numerous points in an arc between cored carbons were determined from measurements of the intensity of the cyanogen bands. The pressure due to carbon was deduced from that of cyanogen by use of the laws of chemical equilibrium. The results are presented graphically. A. W.

3601. Time Variations of Temperature in A.C. Arc Discharges. D. T. J. ter Horst, H. Brinkman and L. S. Ornstein. *Physica,* 2. *pp.* 652–668, *July,* 1935.—Measurements were made of the time variations of temperature of arc gases, as dependent on the phase of the applied a.c. potential, for a series of frequencies between 50 and 500 p.p.s. Oscillographic measurements enabled the energy production per unit volume to be determined. A graphical solution of the differential equation for the energy equilibrium gives results in good agreement with the observations. The theory of the thermal mechanism in the arc column, previously given by Ornstein and Brinkman [see Abstract 3848 (1934)], on which rests the determination of the temperature from the spectral intensities, is confirmed by the results obtained. In the calculations account was taken of the dependence on temperature of the heat conductivity and the specific heat of the arc gases. These functions (for nitrogen in dissociation equilibrium) show a well defined behaviour in the temperature region near the dissociation temperature of nitrogen. A. W.

3602. Oscillations of Atmospheric Mercury Arcs. V. Voss. *Phil. Mag.* 20. *pp.* 166–191, *July,* 1935.—An experimental investigation was made of the operational characteristics of d.c. and a.c. mercury arcs maintained in capillary tubes connected at the ends to larger reservoir tubes. The arcs were started by applying a voltage sufficient to pass a current of, say, 0·1 A through the mercury in the capillary and then heating the tube by means of a small flame until the mercury thread broke, after which an arc was maintained if the conditions were suitable for maintenance. The d.c. arcs frequently exhibited oscillatory effects, the arc gap closing and opening with a definite frequency dependent on the length and diameter of the capillary, the pressure in the arc space and the amplitude of oscillation. A satisfactory explanation of such oscillations is given. It was also found possible to obtain d.c. arcs of greater light intensity without oscillation. In the case of 50-cycle a.c., supply arcs could, by suitable choice of capillary-tube length and diameter and arc current, be maintained with oscillation frequencies of 100, 50, 33⅓ or 25 per sec. For a.c. arcs uniformity of bore of the capillary was found to be essential. With frequencies of 100 and 33⅓ the arc current was alternating, but in the case of the frequencies of 50 and 25 the arc current was unidirectional. A. W.

3603. Velocities of Positive Ions in the Corona Discharge. H. F. Boulind. *Phil. Mag.* 20. *pp.* 68–75, *July*, 1935.—Reliable results for the velocities of positive ions in gases at low pressures can be obtained by the corona-discharge method provided that X/p is less than a certain value. The velocities exceed the values to be expected from mobility determinations at higher pressures, and this indicates that the positive ions in the corona discharge are single particles and not clusters. When the critical value of X/p is exceeded the method becomes inaccurate, but it shows that the velocity increases rapidly with X/p. This increase is attributed to an increase in the mean free path of the ions. High values for the mobilities of positive ions in pure gases have been found by the more precise " four-gauze " method also, and similar large increases in the velocities of positive ions for the higher values of X/p are recorded by Mitchell and Ridler [see Abstract 5167 (1934)]. The increase in mean free path of the positive ions provides an answer to two criticisms of the theory that positive ions may produce appreciable numbers of new ion pairs by collision with gas-molecules. AUTHOR.

3604. Resonance Phenomena in Ionised Gases. W. Sigrist. *Helv. Phys. Acta*, 8. 4. *pp.* 317–320, 1935. *In German.*—Measurements made in a l.v. argon arc show that the ionic plasma behaves as if a series resonance circuit were present and hence it is concluded that in the plasma of a low voltage arc quasi-elastic bound charges must exist, to which a definite natural frequency (resonance frequency) can be assigned. Whether the quasi-elastic bonds have their origin in the fields of the individual ions (microfields), or in effects arising from the mean displacement of the carriers as a whole with respect to one another (macrofield), cannot at present be decided. For the latter case a formula calculated for the resonance frequency gives results of the same order as the observed values. The possibility is suggested of similar effects in the upper atmosphere giving rise to selective fading effects in radio wave propagation. A. W.

3605. Rapid Measurements of Probe Characteristics of a Gas Discharge by Kathode-Ray Oscillograph. J. Dürrwang. *Helv. Phys. Acta*, 8. 4. *pp.* 333–369, 1935. *In German.*—With the aid of a kathode-ray oscillograph a method is developed of photographing the current/potential curve of a probe within 0·1 to 1·0 sec. An alternating potential is applied to the probe but below a certain critical frequency (ca. 100 ∼) the probe curves coincide with those obtained by constant potential probe methods. Typical changes, dependent on the ionisation potentials, are observed in the probe characteristics of a carbon arc when halogen salts of the metals Na, Cu, Cd and Zn are added to it. In the W-N_2 arc the anode fall of potential is found to increase in two steps, 16 and 38 V, when the arc length is increased and to remain constant when the arc length exceeds a certain value. Making use of previous results it is found possible definitely to determine the position of the space potential on the probe characteristic even at high gas pressures. J. E. K.

3606. Dependence of the Ionisation Probability on the Molecular Orientation with Respect to the Colliding Electrons. N. Sasaki and T. Nakao. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 138–140, *April*, 1935. —It was found by Tate and Bleakney, and later confirmed by Lozier [see Abstract 951 (1931)], that when bombarded with 27–40 V electrons H_2 splits up into an atom and an atom-ion. From measurements of the directional distribution of these swift atom-ions round the direction of the electrons it can be seen whether the ionisation probability depends on the molecular orientation with respect to the direction of the electrons. The results obtained with specially constructed apparatus indicate that such a dependence does in all probability exist. A. W.

3607. Ionisation Potential of the Nitrogen Molecule. M. de Hemptinne and J. Savard. *Comptes Rendus*, 200. *pp.* 2147–2148, *June* 24, 1935.—The ionisation potential of nitrogen is measured by Franck's method of electron collisions. The apparatus is an improved Franck apparatus in which not only the electrons which have suffered inelastic collisions but also the ions produced are collected. The ionisation potential is found to be 15·6 V. in agreement with mass spectrographical measurements. Two other critical potentials 21·2 and 23·1 V. are observed and ascribed to the dissociation reactions $N^2(1\Sigma_g^+) = N(^4S) + N^+(^3P)$ and $N^2(1\Sigma_g^+ = N(^4S) + N^+(^1D)$. The calculated energy of dissociation of 6·72 V. agrees well with the value 6·8 V. found by Henry by a different method. J. E. K.

3608. Ionisation Potential of Acetone Vapour. W. A. Noyes, Jr. *J. Chem. Phys.* 3. *pp.* 430–432, *July*, 1935.—The ionisation potential of acetone vapour has been measured with a two-electrode tube. The value found agrees within experimental error with that predicted from spectroscopic data. AUTHOR.

***3609. Discharge Mechanism in All-Metal Gas Discharge Tubes, Especially Canal-Ray Tubes. H. Seemann and G. Orbán.** *Ann. d. Physik*, 23. 2. *pp.* 137–155, *June*, 1935.—Experiments were undertaken with a view to obtaining information which would be of value in the design of efficient canal-ray tubes. About 50 modifications of electrode shape and size were tried before deciding on the most suitable type for a tube using a current of 0·5 – 1·5 mA. and a potential of about 60 kV. An illustration is given of the canal-ray tube finally designed and its details are fully discussed. A. W.

***3610. New Counting Methods for Elementary Particles and Photoelectrons. H. Greinacher.** *Zeits. f. techn. Physik*, 16. 6. *pp.* 165–170, 1935.—The properties of the ordinary discharge counters with electrodes in the form of point and plate, plate and plate, parallel and crossed wires are compared with those of counters with a liquid electrode working on a hydrostatic or hydrodynamical principle. The former does not differ appreciably in its action from the ordinary counter and is useful in the investigation of the photoelectric properties of liquids if care is taken to avoid evaporation. The latter depends on the properties of a fine fluid jet when under the critical conditions between stream-line and tubulent motion. If an electrode charged to + 2000 V. is placed near the jet and an ionising particle passes between electrode and jet the character of the latter is changed. The effect may be registered (1) acoustically by the change in note observed if the jet is impinging upon a stretched membrane, (2) electrically if a circuit is closed by the mechanical impulse exerted by the jet on a metal membrane almost in contact with a fine point, or (3) optically if the deflection of the jet is registered photographically by the interception of a beam of light incident upon a photographic plate. The method is used to exhibit the emission of photoelectrons from water under the influence of light from a Hg lamp and photographic reproductions of the registration of α-, β- and γ-rays are given. F. C. C.

See also Abstract 3303.

CONDUCTION IN SOLIDS AND LIQUIDS.

3611. Electron Theory of Metals. S. Schubin and S. Wonsowsky. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 292–328, 1935. *In German.*—A previous paper given by the authors [see Abstract 2991 (1934)] is amplified and certain points are discussed more fully. In particular, the electrical properties of ferromagnetic bodies are discussed theoretically and two methods are indicated for investigating the origin of the anomalies in the resistance-temperature curves of such bodies. H. J. H. S.

3612. Statistics of Electron Interaction. E. L. Hill. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 447–451, 1935. *In English.*—The influence of the Pauli principle on the interaction of electrons is discussed. It is pointed out that the theory proposed by Wigner and Seitz [see Abstract 433 (1935)] relating the " statistical correlation " to repulsive terms only between electrons with parallel spin components is not sufficiently general and should be replaced by different correlations between electrons with parallel or anti-parallel resultant spins. The calculations for two electrons and for a completely degenerate system of many electrons are given explicitly. [See also Abstract 4369 (1934).] AUTHOR.

3613. Rotating Plate Method for Measurement of Small Light-Indicator Displacements. M. Czerny. H. Heins and W. Woltersdorff. *Zeits. f. Physik,* 95. 3–4. *pp.* 262–264, *June* 4, 1935.—Technical improvements are recorded with respect to an optical instrument previously described [see Abstract 4679 (1934)] for the measurement of small light-pointer displacements. H. H. Ho.

***3614. Electrical Resistances, Compressibilities and Thermal Expansions to High Pressures. P. W. Bridgman.** *Am. Acad., Proc.* 70. *pp.* 71–101, *April,* 1935.—Apparatus and technique necessary to extend the range of pressures from 12,000 to 20,000 kg./cm.^{2} are described. A manganin resistance gauge is used to measure these high pressures, measurements of the resistance change of Au, Ag and Fe with pressures having shown that a linear relationship between its resistance and the pressure can be assumed. The electrical resistance of black P and of single crystal Te in the 23·5° and 86° orientations is measured to 20,000 kg./cm.^{2} at 30° C. and 75° C. In each case the resistance-temperature coefficient is negative but decreases in magnitude as the pressure increases, that for black P becoming positive above 12,000 kg./cm.^{2} The rate of decrease of resistance with pressure drops very rapidly with increasing pressure. Probable minimum values are indicated at 23,000 and 30,000 kg./cm.^{2} for black P and Te respectively. The specific resistance of Te at 20,000 kg./cm.^{2} is still 20 times greater than that of Bi under normal conditions. The resistance of Cu_2S is also studied at these temperatures. At 75° C. irreversible changes occur at the higher pressures. The change of volume of Li, Na and K is measured and the mean linear expansion between 0° C. and 95° C. for these metals has been determined up to 20,000 kg./cm.^{2} At this pressure the order of the expansions of Li, Na and K is exactly the reverse of what it is at atmospheric pressure, K at 20,000 appearing as the " hardest " and Li as the " softest " metal. It appears from the present data that considerably higher pressures must be applied to reduce the entropy of these metals to zero. R. W. P.

3615. Influence of Pressure on Electrical Resistance of Hard Drawn Gold Wire in Different Stages of Annealing, and of Soft Gold Wire. A. Michels and M. Lenssen. *Physica,* 2. *pp.* 591–596, *July,* 1935.—Measurements on the influence of pressure on the electrical resistance of gold wire in different states of hardness were carried out to obtain information as to the effect of the "rest-resistance" on the pressure coefficient. The apparatus used was similar to that previously described [see Abstract 1291 (1930)]. Tables of results are given together with a short discussion. The results obtained supply data to test whether Matthiesen's rule holds for the case where the chemical composition of the material is kept constant, but the stresses, etc., are altered. A theoretical discussion of the results will be given in a subsequent paper. R. L.

3616. Surface-Force Theory of Rectification in Ionic Crystals. S. R. Khastgir. *Indian Journ. Phys.* 9. *pp.* 347–355, *May,* 1935.—An explanation of contact-point rectification in symmetrical ionic crystals is proposed in terms of a theory based on the presence of an unbalanced electrostatic force on the surface of the crystal. The asymmetry and curvature of the current-voltage characteristic curves are explained by taking into consideration the electrostatic force together with the heating effect at the point of contact and the effect of strain on the crystal. The necessity for a point contact is emphasised and the different degrees of rectification for different points on the crystal surface are explained. A number of experimental results for symmetrical ionic crystals are explained in terms of the theory and a brief mention is made of volume rectification in crystals having no centres of symmetry. H. J. H. S.

3617. Influence of Vapours and Occluded Gases on Electrical Conductivity of Cuprous Oxide. L. Dubar. *Comptes Rendus,* 200. *pp.* 1923–1925, *June* 3, 1935.—Experiments are described showing that the increase in the conductivity of Cu_2O when thoroughly dried or placed in a vacuum is due to removal of H_2O and occluded gas. [See Abstract 436 (1935).] C. A. S.

3618. Electrical Conductivity and Chemical Equilibrium of Electrolytes in Gelatin Solutions. W. Ehrenberg and P. Wulff. *Kolloid-Beihefte,* 42. *pp.* 1–32, *June* 1, 1935.—The following parallel determinations have been carried out on electrically dialysed 0·3–8·2 % gelatin and variable quantities of NaOH, NaCl, AgCl and Ag_2O namely: conductivity measurements, potentiometric and colorimetric pH determinations, potentiometric Ag activity measurements and chemical analyses. It is shown *inter alia* that the conductivity of aqueous NaCl solutions decreases on the addition of gelatin. Two effects are separated from this decrease in conductivity, *viz.*, the resistance effect due to the size of the gelatin particles for all concentrations and the resistance due to the electrical force of the gelatin particles found at low concentrations of NaCl. J. K.

3619. Conductance of KCl and of HCl-DCl in H_2O-D_2O Mixtures. Viscosity of H_2O-D_2O. W. N. Baker and V. K. La Mer. *J. Chem. Phys.* 3. *pp.* 406–410, *July,* 1935.—The conductances of 0·01 *N* KCl and of HCl-DCl in H_2O–D_2O mixtures, and the viscosities of H_2O–D_2O mixtures, have been investigated as a function of D_2O concentration at 25° C. The viscosity of D_2O is 23 % greater, the conductance of KCl in D_2O is 17 % less, and the conductance of DCl in D_2O is 26 % less, than the corresponding values in H_2O. The viscosity, and the conductance of KCl solutions and of HCl-DCl solutions show a maximum deviation of

0·4, 0·8 and 5·4 % of the total values, respectively, from linearity. The decreased conductance of KCl solutions in D_2O is due mainly to the increased viscosity of the solvent. The marked deviation from linearity of the HCl-DCl curve is interpreted on the basis of a statistical correction to the proton exchange mechanism for the mobilities of H_3O^+ and D_3O^+ in H_2O–D_2O mixtures. AUTHORS.

See also Abstracts 3250, 3596, 3668, 3669, 3682, 3691.

DIELECTRICS AND CAPACITANCE.

3620. Dielectric Constants of Gases and Vapours. M. Kubo. *Inst. Phys. and Chem. Research Tokyo, Sci. Papers, No.* 576. *pp.* 65–73, *June,* 1935. *In English.*—Electric moments and atomic polarisation for n-propyl, n-butyl, and allyl alcohols were determined, in completion of previous work [see Abstract 2706 (1935)]. The values of the molecular polarisation and the other constants calculated from Debye's formula $P = A + B/T$ are tabulated for various pressures and the electric moments calculated. The results obtained together with those of the previous paper are discussed with reference to their bearing on molecular structure. Special reference is made to studies of the dielectric constants of liquids for very high frequencies at low temperatures. A. M. T.

3621. Moments of Two Molecules Containing Movable Dipoles. C. P. Smyth and K. B. McAlpine. *Am. Chem. Soc., J.* 57. *pp.* 979–983, *June,* 1935.—The dielectric constants of the vapours of trimethylene chloride and 1,1,2,2-tetrachloroethane have been measured and the results used to calculate the dipole moments of the two molecules, which show no variation with temperature over the range studied. Calculation of the internal energies of the molecules shows that the movable dipoles should oscillate in potential energy troughs in such a way as to give effective resultant moments not far from those observed and possessing a variation with temperature considerably smaller than that of ethylene chloride and, possibly, so small as to be undetectable in the temperature region studied. AUTHORS.

3622. Polarisation of Liquids. F. R. Goss. *Chem. Soc., J. pp.* 727–731, *June,* 1935.—The molecular anisotropy factors A_E and A_{E+A}, arising respectively from the local asymmetry of the optical and the electrical polarisation field, in liquids, have in earlier work been assumed to be equal. This equality is now proved for CCl_4. The "false" orientation polarisation of liquid benzene, previously noted and attributed to the presence of coordinate links, is measured over a range of temperature. Several expressions for molecular refraction are compared from the point of view of their independence of temperature. [See Abstract 2712 (1935).] AUTHOR.

3623. Relation between Molecular Polarisation in Solution and the Dieletric Constant of the Solvent. R. J. W. le Fèvre. *Chem. Soc., J. pp.* 773–776, *June,* 1935.—The expression ${}_0P_1/{}_0P_2 = K(\epsilon_2 + 2)/(\epsilon_1 + 2)$, in which ${}_0P_1$ and ${}_0P_2$ are the orientation polarisations of a solute molecule in two media of dielectric constants ϵ_1 and ϵ_2 respectively, appears to be valid over a wide range of ϵ values. Three groups of examples of its applicability are given in tables: (*a*) for pairs of solutions, (*b*) for solutions, and the corresponding solutes in the vapour states, and (*c*) for solutions, and the (liquid) solutes in bulk. AUTHOR.

3624. Temperature Distribution Due to Joule's Heat of a Sphere in a Homogeneous Electric Field. W. Krasny-Ergen. *Ann. d. Physik,* 23. 3. *pp.* 277–284, *June,* 1935.—If an inhomogenous body is placed in either a d.c. or a.c. field then, in consequence of the variability of the material the field will alter and in general be inhomogeneous also. So far as the conductivity of the body differs from nil, Joule's law exists in each volume element and for each unit of time creates a definite quantity of heat. The inhomogeneity of the field on the one hand, and the variation in conductivity on the other, of the different particles of the body causes this quantity of heat to vary from place to place. The temperature differences which follow may be treated by means of the laws for heat propagation. For different uses of the electrical current it is of interest to be able to calculate at any time the temperature field which has been created, a calculation which is only possible in simple cases. The present work assumes a homogeneous isotropic body in which an a.c. field is established (the case of the non-alternating field is easily deduced by assuming a frequency nil in the expression derived). Two planes normal to the lines of force of the homogeneous field are assumed and are maintained at equal constant temperatures. In the middle of the above body between the two planes is introduced an isotropic homogeneous sphere, of radius small compared with the distance between the planes and compared with the distance between the planes and compared with the distance of the sphere from the limiting surfaces of the first named body. The heat evolution of the sphere surface is calculated from the Newton cooling law and conduction and convection are neglected. The problem is then investigated theoretically, and a formula derived the application of which and its discussion is postponed to a later paper. S. G. B.

3625. Effect of Pressure on the Dielectric Constant, Power Factor and Conductivity of Rubber-Sulphur Compounds. A. H. Scott. *Bureau of Standards, J. of Research,* 15. *pp.* 12–33, *July,* 1935.—The dielectric constant, power factor and conductivity of rubber-sulphur compounds containing from 0 to 32 % of S were measured while subjected to pressures ranging from 1 to 700 bars. The dielectric constant and power factor were measured at 1000 ∼ and the conductivity at the end of 1-min. electrification. The effect of pressure on each was found to change with S content. The dieletric constant up to about 7½ % of S increased slightly with pressure. For higher percentages of S it decreased with pressure. The power factor up to about 2 % of S was independent of the pressure. For percentages of S from 2 to about 12 % the power factor increased with pressure; for higher percentages of S it decreased with pressure. The conductivity between about 12 and 19 % of S increased with pressure, while it decreased with pressure for other percentages of S. Curves are presented which show the effect of pressure for any possible composition. The effect of pressure on two specimens of gutta-percha over the same pressure range was determined and the results are given for comparison. AUTHOR.

***3626. Dielectric Losses of Liquid Dielectrics. H. Rieche.** *Zeits. f. Physik,* 95. 3–4. *pp.* 158–178, *June* 4, 1935.—The development of a method for the determination of the losses and loss factor of liquid dielectrics for a frequency range of smallest possible to 150,000 kc. and a temperature range of − 60 to 100° C. is described. The apparatus used is a h.f. calorimeter of new design. An adiabatic principle is used in conjunction with automatic temperature recording. Tests on transformer oil, nitrobenzene and benzene gave the following results. The causes of the losses did not appear capable of an explanation based on the inhomogeneity theory of Wagner. The curves obtained for transformer oil may be explained by application of the Debye's dipole theory. The occurrence of a Wagner effect at low frequencies simultaneously with a dipole effect at high frequencies was not found. The tests on nitrobenzene confirmed these deductions. No loss could be detected in the case of benzene, which is not a dipole substance, at the solidification point. A. M. T.

See also Abstracts **3338, 3595, 3596.**

ELECTROCHEMISTRY.

3627. Electrolytic Dissociation of Heavy Water. E. Abel, E. Bratu and O. Redlich. *Zeits. f. phys. Chem.* 173. *Abt.A.* 5. *pp.* 353–364, 1935.—The e.m.f.s of the cells D_2 | DCl (0·1 *M*) | AgCl | Ag and D_2 | NaOD (0·1 *M*) + NaCl (0·1 *M*) | AgCl | Ag are measured. From the results it follows that the ratio of the electrolytic dissociation constant of D_2O to that of H_2O is 0·16 at 21° C. In the theoretical part of the paper it is pointed out that for mixtures of light and heavy water the product of the total activity of the isotopic H-ions and the total activity of the isotopic OH-ions (the so-called ionisation function) plays a similar part to that of the dissociation constant for pure water. The "normal potential" of D_2 (in heavy water) relative to the H_2 electrode (in light water) is shown to be − 0·003 V. L. A. W.

3628. Electrochemical Behaviour of Ammonium Amalgum under Pressure. S. v. Náray-Szabó and L. Szlatinay. *Zeits. f. phys. Chem.* 173. *Abt.A.* 2. *pp.* 89–102, 1935.—Pressures of 30 to 60 atmospheres at 0°C. have been employed. As standard electrode Hg/Hg_2Br_2, NH_4Br was employed, the potential of which was found to be fully constant and reproducible with respect to a calomel electrode. To measure the potential of the ammonium amalgum the electrolysis is stopped for 1/40 sec. The kathode potentials measured in this way show that they are dependent on the NH_4^+ activity of the solution in contradistinction to an independence with respect to the pH, as long as the latter is not so great that separation of ammonium amalgum is impossible, and that there is a linear relationship between the potential and logarithm of the current density $\epsilon H = a - b \log I/q$ (ϵH = Potential, determined against a *n*-hydrogen electrode, *a* and *b* constants, I = strength of current, q = kathode surface). From this it is concluded that NH_4-ions separate in the same way as H-ions according to the investigations of Erdey-Grüz and Volmer, *i.e.*, the occurrence of the lag in the potential determination is due to the neutralisation of the NH_4^+ ions. J. K.

3629. Transport of Electricity through Phase Boundaries. E. Manegold and C. Stüber. *Zeits. f. phys. Chem.* 173. *Abt.A.* 5. *pp.* 321–344, 1935.—The passage of ions through a glass diaphragm which was in contact with Hg or fused silver nitrate was studied. Two forms of transport of electricity at the boundaries were distinguished, (1) transport without migration of material particles (electronic conduction) and (ii) transport with the migration of material particles (ionic conduction). The existence of complex silicate ions was indicated. F. J. B.

3630. Electrolysis of Nickel and Cobalt Chlorides in Aqueous Ethyl Alcohol Solution. C. Charmetant. *Comptes Rendus,* 201. *pp.* 43–45, *July* 1, 1935.—When a solution in aqueous ethyl alcohol containing 80 gm./l of $NiCl_2$ is electrolysed with Pt electrodes and c.d. 1–4 amperes/dm.^{2} the anodic phenomena are similar to those with $ZnCl_2$ [see Abstract 1817 (1935)]. Nickel oxide (50–55 % Ni) is first deposited on the kathode, but is dissolved as acid spreads from the anode, and as soon as any metal is bare Ni is deposited; this occurs the more quickly the higher the c.d. but with lower yield, and with more difficulty as the concentration in EtOH is higher. No oxide is deposited if the solution is slightly acid to begin with. The yield in Ni diminishes with time and increased c.d., with increasing concentration in EtOH it at first decreases and then increases. Phenomena with $CoCl_2$ are similar save that under no circumstances is any oxide deposited. C. A. S.

3631. Current-Producing Processes in Concentration Gradients in Solid Electrolytes. W. Schottky. *Wiss. Veröff. a.d. Siemens-Werken,* 14. 2. *pp.* 1–19, 1935.—The possibility of transforming chemical energy into electrical energy with the help of heated solid electrolytes is considered. A theoretical treatment is given for the case in which a gaseous reactant passes from a region of higher to a region of lower chemical potential through the solid electrolyte. The main technical difficulties which would be encountered in the attempt to realise this type of current production are discussed, and it is concluded that this kind of process may possibly be more advantageous than that using molten electrolyte. L. A. W.

3632. Hydrogen Overvoltage. P. Porfirov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 386–392, *Feb.* 21, 1935.—It is concluded that there is no doubt as to the existence of contact resistance on a Hg kathode, and that this contact resistance is not the only cause of hydrogen overvoltage; that a hydrogen film causing the contact resistance begins to form at a very low kathode polarisation; that the contact resistance decreases with increase in d.c. density, and that the maximum resistance of the film coincides with the beginning of the increase in the strength of the current in the potential-current density curve. Abridged tabulated summaries of the results of the experiments are given. J. K.

3633. Oxygen Overvoltage in the Electrolysis of Fluid Mixtures of the Salts KNO_3—$NaNO_3$—$LiNo_3$. S. Karpatscheff and W. Patzug. *Zeits. f. phys. Chem.* 173. *Abt.A.*5. *pp.* 383–387, 1935.—The anode overvoltage in fused mixtures of nitrates of NaK and Li was measured at temperatures of 150°, 200° and 250° C. The overvoltages of the fused ternary eutectic, the binary eutectics of sodium and potassium, as well as a non-eutectic ternary mixture were also measured. The overvoltage measured and its dependence upon the current density can be expressed by the equation $\eta = a + RT/aF \cdot \log J$, where a is a constant depending on the mixture of salts. F. J. B.

3634. Influence of Light on Anodic Polarisation of Tungsten. J. P. E. Duclaux. *Comptes Rendus,* 200. *pp.* 1838–1840, *May* 27, 1935.—When a plate of W is made anode in an acid solution it rapidly polarises, and the resistance rises to some 10^7 ohms; the colour of the plate passes through brown to blue and finally yellow as the voltage is increased. On removal of the current and short circuiting through a high resistance depolarisation takes several hours. The phenomena observed indicate formation of a layer of oxide. The rapidity of depolarisation is greatly increased by ultra-violet light, an effect probably due to displacement of the oxidation-reduction equilibrium. C. A. S.

3635. Theory of E.M.F. in Electrolytes. M. Planck. *Preuss. Akad. Wiss. Berlin, Ber.* 8. *pp.* 147–149, 1935.—A report is given of a discussion of Nernst's assumption that in the interior of the electrolyte solution the concentrations of kations and anions everywhere approximately neutralise one another. It is pointed out that exact neutralisation cannot be assumed, and the practical effect of the approximation is investigated for the case of the boundary layer between two different electrolyte solutions. The details of the treatment are reserved for a later publication, but a result is given for the minimum thickness which the boundary layer may have so that the Nernst assumption may remain approximately valid. This critical thickness decreases with increase of concentration: for a concentration of 0·001 *N.* it is of the order of 10^{-6} cm. It is concluded that so long as it is justifiable to consider the concentration as being continuous (a fundamental assumption of the theory) the Nernst assumption must hold with good approximation.
L. A. W.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3636. Mass Ratio of Proton and Electron. H. Ertel. *Phys. Zeits.* 36, *pp.* 464–465, *July* 1, 1935.—Eddington's value for the mass ratio m_+/m_- [see Abstract 1515 (1932)] is now obtained from a reciprocal quadratic equation based on the postulate that the approximation, $\sqrt{m_+/m_-} \approx 136/\sqrt{10}$, should be converted by symmetrical completion of the left side into a definite equation for m_+/m_-: $\sqrt{m_+/m_-} + \sqrt{m_-/m_+} = 136/\sqrt{10}$; by the transformation $\sqrt{m_+/m_-} = \mu\sqrt{10}$, the Eddington equation, $10\mu^2 - 136\,\mu + 1 = 0$, is obtained. The necessary alterations in the wave-mechanical equation are discussed. The paper is entirely mathematical.
H. H. Ho.

3637. Production of Electrons and Positrons by Collision of Material Particles. Part II. E. Lifshitz. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 385–398, 1935. *In English.*—The cross-section for the production of electronic pairs by a collision of two particles with a velocity much less than that of light is calculated. The effects of the first and the second approximation are compared. [For Part I see Abstract 475 (1935).]
AUTHOR.

3638. Ionisation Curve of Protons. R. Grégoire. *Comptes Rendus,* 200. *pp.* 2164–2166, *June* 24, 1935.—Together with the ionisation curve for α-particles from Po, which was practically identical with that of Naidu [see Abstract 1961 (1934)], a second curve was found, the maximum of which was half that for the α-particles, and which indicated a trajectory in air at 15° and 760 mm. of only 31 mm. (as compared with 35 mm. for the α-particles). The number of particles producing this curve was only 1 % of that of the α-particles, and their mass and charge alike 1. This curve is therefore that of protons; it did not occur if H_2O had been rigorously excluded.
C. A. S.

3639. Energy Distribution of Secondary Electrons from Molybdenum. L. J. Haworth. *Phys. Rev.* 48. *pp.* 88–95, *July* 1, 1935.—Energy distribution curves of secondary electrons from a thoroughly outgassed Mo target have been obtained by magnetic analysis with primary electron energies up to 150 V. In addition to the usual sharp "elastically reflected" peak and the broad, low energy maximum, other maxima and irregularities appear which may be classified as follows: (1) peaks at energies 10·6, 22 and 48 V. less than the primary energy which are due to critical energy losses among the inelastically scattered electrons; (2) " humps " in the curves at secondary energies of 11, 24 and 35 V., independent of the primary energy. The number of elastically reflected electrons is plotted as a function of primary energy. This curve exhibits several maxima, some of which are correlated with the " critical potentials " giving rise to the peaks of type (1). Others are due to electron diffraction. A discussion of possible applications of modern metallic theories to the present results is given. Two of the peaks of type (1) and all of those type (2) are tentatively accounted for. AUTHOR.

3640. Secondary Emission of Electrons from Complex Targets. P. L. Copeland. _Phys. Rev._ 48. _pp._ 96–98, _July_ 1, 1935.—Secondary emission of electrons from complex targets formed by the condensation of some substances on others has been investigated. The change in the secondary emission with the primary energy appears to be dominated by the overlying element in the low energy range and by the base metal in the range of high primary energies. The total secondary emission in certain ranges may be less or greater than that obtained from either constituent of the complex target when used alone. [See Abstract 3904 (1934).] AUTHOR.

3641. Diffraction of Fast Electrons by Crystallised Rock-Salt. S. Pinsker. _Phys. Zeits. d. Sowjetunion_, 7. 4. _pp._ 464–467, 1935. _In German._—Various diffraction patterns formed when electrons of energy about 40 kV are incident on crystallised rock-salt are discussed and a few are reproduced. A remarkable point interference pattern is also observed. The physical phenomena responsible for the results, _i.e._, the mosaic structure of the crystals, the deformation of the single crystals, divergence of the incident electron beam and the degree of fulfilment of the third Laue condition, are in progress of further examination. F. C. C.

3642. Elastic Scattering of Electrons in Krypton. A. L. Hughes and S. Bilinsky. _Phys. Rev._ 48. _pp._ 155–160, _July_ 15, 1935.—In order to compute the elastic scattering coefficients for electrons colliding with atoms it is necessary to evaluate the wave-mechanics expression

$$I(\theta) = (1/4k^2) \left| \sum_{n=0}^{\infty} (2n+1)\,(e^{2i\delta_n} - 1)P_n(\cos\theta) \right|^2.$$

Improvements in the method of summing the series and in evaluating the phases (particularly δ_0) have been effected. The computed scattering coefficients are in satisfactory agreement with the experimental values for electrons of energy 250, 350 and 510 V; the agreement is less satisfactory for electrons of energy 780 and 950 V. In the range over which satisfactory agreement is obtained, the Hartree field gave somewhat better results than the Fermi-Thomas field. AUTHORS.

*3643. **Electron Microscope and Its Applications. L. Marton.** _Rev. d'Optique_, 14. _pp._ 129–145, _April_, 1935.—A brief account is given of the application of electron optics to electron miscroscopy. The author then describes his work on the application of a magnetic electron microscope to a study of biological objects (which normally are destroyed by the electron discharge). These are impregnated with osmium in such a way that a framework of the object is preserved although the object itself is destroyed. This framework is mounted on a Cu net or thin Al foil so that heat and charge may be conducted away. Cell structures have been examined at magnifications up to 1,000. H. J. H. S.

***3644. Electron Optics of Centred Systems. E. Henriot.** *Rev. d'Optique*, 14. *pp.* 146–158, *April*, 1935.—The analogy between axially symmetrical electric or magnetic fields and an ordinary optical system is developed by a consideration of the behaviour of an electron in such fields. The focal length of a short solenoid magnetic lens is deduced. The possible resolving limit and the aberrations present in an electron-optical system are briefly discussed. H. J. H. S.

***3645. Resolving Limit of the Electron Microscope for Irradiated Objects. W. Henneberg.** *Zeits. f. Instrumentenk.* 55. *pp.* 300–305, *July*, 1935.—The resolving limit of an electron microscope is derived by analogy from the optical case on the assumption that the electrons have a wave-length given by the de Broglie formula. The limit is derived for 3 simple cases, *viz.*, when the object is situated outside the magnetic field of a short solenoid, when a limiting layer of electric field divides the object distance in a definite ratio and when the object is in an accelerating field. The same relation is found to hold for the optical and electron-optical systems. H. J. H. S.

***3646. 3-Phase Rotating-Film Kathode-Ray Oscillograph. R. V. Whelpton.** *Journ. Sci. Instruments*, 12. *pp.* 226–233, *July*, 1935.—The paper describes the construction, operation and performance of a 3-phase kathode-ray oscillograph designed to give records covering several fiftieths of a second on a time scale such that oscillations of all frequencies up to 100,000 cycles can be accurately measured. This demands a record several yards long. A photographic film is revolved at high speed and three beams of electrons are projected on to it. The apparatus is particularly designed for circuit breaker testing, but other applications of its use are given. AUTHOR.

See also Abstracts **3216, 3239, 3261, 3264, 3404, 3605, 3665, 3666, 3703.**

ELECTROSTATICS.

3647. Contact P.D. Between Tungsten and Barium. External Work Function of Barium. P. A. Anderson. *Phys. Rev.* 47. *pp.* 958–964, *June* 15, 1935.—The electron method is developed to measure the contact potential between W and Ba. Great care is taken to obtain the W as pure as possible; it is cleaned by flashing at 2800° K. until its work function remains constant. The tube is outgassed at the highest vacuum, gettered with Ba and immersed in liquid air. There is a sharp localisation of the surface areas for which electron current—potential characteristics are taken, displacement of the characteristic determines the retarding potential. Ba films are deposited on the W ribbon by thermal vaporisation. Results for different sources of W and Ba give the value $2 \cdot 13 \pm 0 \cdot 05$ V for contact potential and $2 \cdot 39 \pm 0 \cdot 05$ equivalent volts for the external work function of Ba. H. M. B.

***3648. Bifilar-Suspension Electrometer. F. Charron.** *Comptes Rendus*, 200. *pp.* 1834–1835, *May* 27, 1935.—When a horizontal bar, suspended by two parallel wires of equal length, is rotated through an angle, the bar is raised slightly. This fact may be made use of in the measurement of small vertical forces, as in a microbalance. If the bar is replaced by a sphere and suspended by two equal and parallel wires just above a plane surface, the system may be used as an absolute electrometer. The paper discusses the conditions of stability, the sensitivity, and the damping of such a system. J. S. C.

3649. Chemical-Electrical Curie-Point Effect Analogous to the Chemical-Magnetic Effect. J. A. Hedvall and R. W. Pauly. *Zeits. f. phys. Chem.* 29. *Abt.B.* 3. *pp.* 225–230, 1935.—Several investigators have opined that orienting fields of an electrical character exist in Rochelle salt, which within certain temperature ranges cause the salt to exhibit properties which are analogous to the magnetic phenomena of ferromagnetic substances. The experiments now described have confirmed previous anticipations, the discontinuous change of the above field at the upper electrical Curie-point of the salt at about 22°–23° being accompanied also by an abrupt alteration in the chemical properties, as is the case at the magnetic Curie-point of nickel. H. H. Ho.

See also Abstracts **3393, 3456, 3582.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3650. Galvanomagnetic Phenomena in Crystals. J. Frenkel and T. Kontorowa. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 452–463, 1935. *In English.*—The galvanomagnetic phenomena in divalent metals with cubic symmetry are discussed in an elementary way by tracing the action of the electric and magnetic fields on the separate electrons and positive holes. The main feature of the method consists in the subdivision of the electrons into three groups, corresponding to the symmetry axes of the crystal, the mobilities of the electrons in each group being different for different directions of the external force. The results of this elementary theory are in exact agreement with those of the much more complicated calculations of Blochinzew and Nordheim [see Abstract 4667 (1933)] for the Hall effect and the resistance effect in a transverse magnetic field. In addition an expression is derived for the change of resistance in a parallel magnetic field, yielding a coefficient of the correct order of magitude in the quadratic law for weak and moderate field strengths. Authors.

3651. Influence of Magnetisation by Heat and of Crystallisation on the Form of the Thermomagnetic Curves. A. Michel and G. Chaudron. *Comptes Rendus,* 200. *pp.* 2171–2173, *June* 24, 1935.—Curves are examined for iron sesquioxide, ferrite of barium, ferrite of lead. A distinct irreversible effect on the magnetisation is noted in these cases a little before the Curie point. After recooling, the body has a strong remanent magnetisation. Bodies which exhibit the phenomenon of magnetisation by heat have been observed to show its existence at the following temperatures: Fe_2O_3 rhombohedral crystals at 1250°, barium ferrite and lead ferrite at 950°. A chemical effect accompanies this change in magnetisation, the chemical affinity is diminished and the oxides are only soluble in acids with difficulty. On feebly ferromagnetic bodies demagnetisation by heating above the Curie point becomes difficult or impossible when the temperature arrives near that indicated previously for the creation of the effect. Crystallisation modifies the form of the thermomagnetic curves profoundly. It is shown that crystallisation provokes displacement (apparent) of the Curie point, and it is necessary, in order to identify a body above the temperature of its anomalous behaviour, to work with a product that is properly and well crystallised. S. G. B.

3652. Crystal Structure and Electrical Properties. Part VI. Real Electrical Conductivity of Single Bi Crystals in a Magnetic Field. O. Stierstadt. *Zeits. f. Physik,* 95. 5–6. *pp.* 355–364, *June* 17, 1935.—The question raised is how far and in what direction are the values of the conductivity as affected by the influence of a magnetic field useful in the definition of the electrical characteristics of a crystalline lattice. The real parameter of the magnetic alteration of resistance for Bi crystals is primarily reviewed, defined and the correction of the Kohler expression for its calculation in weak magnetic fields is given. The deductions from the derivation of this parameter are utilised for the solution of conductivity questions in crystals in particular, the important application to the discussion of the anisotropic electrical conductivity of a crystalline lattice in a magnetic field. The various characteristic cases are given. [For Part V see Abstract 2269 (1935).] S. G. B.

3653. Magnetic Alteration of Resistance of Metallic Crystals. M. Kohler. *Zeits. f. Physik,* 95. 5–6. *pp.* 365–382, *June* 17, 1935.—An earlier paper [see Abstract 5237 (1934)] investigated the relationship between the magnetic resistance alteration and the crystallographic orientation of the magnetic field strength and the electrical current strength for small magnetic fields, where the alteration in resistance is proportional to the square of the field strength. Stierstadt [see preceding Abstract] compared the results of experiment with those of theory for Bi. His lowest field strength was 3000 AW/cm., and was not low enough in many cases to demonstrate the validity of the law. The work of Stierstadt throws new light upon the question and allows an exact calculation of the resistance parameter to be made. Deviations from the quadratic law appear for Bi at room-temperature at about 1000 AW/cm. By means of the determination of the values of Ohm's law resistance the relationship of the alteration of the resistance to the orientation of the current and magnetic field was arrived at for higher values. The variations from the rules applicable to small fields are elucidated theoretically and set out clearly. The paper is theoretical throughout. S. G. B.

3654. Influence of a Magnetic Field on the Thermal Conductivity and Viscosity of a Paramagnetic Gas. M. v. Laue. *Ann. d. Physik,* 23. 1. *pp.* 1–15, *May,* 1935.—A theoretical investigation is made of the behaviour of a paramagnetic gas in a uniform magnetic field on the basis of the kinetic theory, and it is found that no simple relation exists between the field strength and either the thermal conductivity or the viscosity. The change in the conductivity and in the viscosity brought about by the magnetic field is expressed as a series containing coefficients which depend on the field strength and the density and temperature of the gas.

H. J. H. S.

MAGNETISM AND ELECTROMAGNETISM.

3655. Magnetisation Curve of Single Iron Crystals. R. Jaanus. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 380–384, 1935. *In German.*—It is shown that the conclusions of Hill [see Abstract 5243 (1934)] on the magnetisation curve of single iron crystals, which were made on the basis of his measurements on a single crystal test piece in the form of a closed ring, are incorrect. J. J. S.

3656. Gadolinium, a New Ferromagnetic Metal. G. Urbain, P. Weiss and F. Trombe. *Comptes Rendus,* 200. *pp.* 2132–2134, *June* 24, 1935.—Gadolinium, recently isolated, contained foreign matter of less than 0·73 %, *i.e.*, 0·7 % silicium and 0·03 % of iron. In this condition of purity it is ferromagnetic. The following details are relevant: (1) The Curie point is situated at the ordinary temperature, 16° ± 2° C. (2) From the boiling point of nitrogen (77° K.) to the Curie point, great magnetic durability is found, the value of the coefficient a of the law $\sigma_H = \sigma_\infty (1 - a/H)$ when the metal is in liquid nitrogen being above 1250 (a for iron is less than 10). The specific magnetisation in high fields exceeds that of iron. The absolute saturation value found by methods indicated in the paper attained a value of 253·5 U.C.G.S., whilst for iron the value is equal to 221·7. The atomic moment corresponding to gadolinium is 35·4 magnetons which is more than three times greater than that of iron (11 magnetons). S. G. B.

3657. Magnetisation of Ferromagnetic Powders. H. Forestier. *Comptes Rendus*, 201. *pp.* 45–47, *July* 1, 1935.—The acquisition by ferrites prepared by precipitation, of residual magnetism when cooled in a magnetic field after having been heated therein above the Curie point is more marked in feeble fields; in the case of the cubic ferrites it disappears entirely with strong fields, but in that of those of hexagonal type, *e.g.*, ferrites of Ba, Sr or Bb, it only becomes much less; the unstable ferrites, as of Ca or Cd do not exhibit the phenomenon. In magnetite it only appears when very finely powdered. Hematite behaves similarly, but a crystal of specular hematite heated in a field parallel to its ternary axis shows very strong magnetisation, but none when this is perpendicular thereto. Cementite behaves as the stable ferrites, but pure Fe (prepared by reduction at low temperature) as the unstable, showing no residual magnetism after heating. The phenomena thus depend on strength of field, fineness of grain and crystal structure. C. A. S.

3658. Fe-Ni-Cu Alloys of High Initial Permeability. O. v. Auwers and H. Neumann. *Wiss. Veröff. a. d. Siemens-Werken*, 14. 2. *pp.* 93–108, 1935.—The magnetic properties of a number of commercial alloys of high initial permeability are briefly described and a preliminary form of ternary diagram is suggested from the work of previous authors. Experimental work on a number of alloys of the Fe-Ni-Cu system is then described. The magnetic properties of the alloys are examined and a number of three-dimensional models are given which show the lines of identical initial permeability, coercivity, induction at 10 G. and of magnetostriction nil for the system Fe-Ni-Cu. A zone of high initial permeability and small coercivity is found extending from an alloy containing 80 % Ni and 20 % Fe to one containing 40 % Ni, 50 % Cu and 10 % Fe; in this region the magnetostriction of the alloys of highest initial permeability changes sign. H. J. H. S.

***3659. Magnetic Measurements on Molecular Compounds in Solution with a Modified Form of Decker's Balance. S. S. Bhatnagar, M. B. Nevgi and G. Tuli.** *Indian Journ. Phys.* 9. *pp.* 311–317, *May*, 1935.—An attempt has been made to study the stability of molecular compounds in solution from a magnetic standpoint, by measuring the diamagnetic susceptibility of some picrates in the solid state and in solutions in extra pure benezene over a wide range of concentrations. It is found that the susceptibility of the compounds is lowered in solutions and the value approaches that given by the law of mixtures, from which it is concluded that the molecules are dissociated in solution. AUTHORS.

***3660. Magnetic Susceptibility of Bromine Vapour. J. Shur and R. Jaanus.** *Phys. Zeits. d. Sowjetunion*, 7. 4. *pp.* 501–506, 1935. *In English.*—An apparatus is described for the determination of the magnetic susceptibility of chemically active vapours. The specific susceptibility of the vapours of bromine has been measured. Its value $\chi = -(0{\cdot}46 \pm 0{\cdot}04) \times 10^6$ agrees very well with that found by M. Owen for liquid bromine ($\chi = = -0{\cdot}40 \times 10^6$). [See Abstract 1113 (1912).] AUTHORS.

3661. Magnetic Susceptibilities of Salts of the Iron Group Elements. R. B. Janes. *Phys. Rev.* 48. *pp.* 78–83, *July* 1, 1935.—Measurements of the paramagnetic susceptibilities of powdered crystals of several salts of the iron group elements have been made over the temperature range 80° to 300° K. The results are in good agreement with the theoretical predictions of van Vleck and his co-workers in the cases where the theory is applicable. Several of the nickel and cobalt complex salts have susceptibilities which vary in an unusual manner with the temperature. AUTHOR.

3662. Quantum Electrodynamics. M. Born. *International Conference on Physics, London,* 1934, *Vol. I. Nuclear Physics, pp.* 19–27, *Physical Society.*—The paper is a short account of several publications by the author and L. Infeld, in which the idea of a unitary field theory is formulated. Instead of the different fields for all types of particles (electrons, protons, neutrons, neutrinos) a single electromagnetic field satisfying certain field equations which are modifications of Maxwell's equations is assumed. In these new equations the electric and magnetic field vectors are expressed in units of an absolute field, and they are invariant to general transformations. The classical treatment leads to the existence of an electron with finite energy; it is possible to define a length, the radius of the electron, of definite numerical relation to the mass. The general solution of the 2-dimensional electrostatic problem has been found by M. H. L. Pryce [see Abstract 1008 (1935)]. The quantum treatment is based on the assumption of commutation laws for the field components, considered as q-numbers. A closed electromagnetic system is shown to behave like a mass point satisfying the laws of quantum mechanics. AUTHOR.

3663. Electrodynamics of Born and Infeld. B. Kwal. *Comptes Rendus,* 200. *pp.* 1656–1657, *May* 13, 1935.—Deduces certain relations in the Born-Infeld theory which bear on the question of the presence of infinite terms in the expression for the electromagnetic energy of a closed system. W. S. S.

3664. Electromagnetic Waves in Gravitational Fields. S. C. Dhar. *Indian Phys. Math. J.* 6. *pp.* 15–18, *April,* 1935.—The solutions of the generalised Maxwell equations found by Whittaker [see Abstract 695 (1928)] for the Schwarzschild metric are generalised for the case when the metric is of the form $ds^2 = f(r)dt^2 - (1/C^2)\ (dr^2/f(r) + r^2 d\theta^2 + r^2 \sin^2\theta\ d\phi^2)$. G. C. McV.

3665. Linear Modifications in the Maxwell Field Equations. R. Serber. *Phys. Rev.* 48. *pp.* 49–54, *July* 1, 1935.—Expressions, accurate to the first order in e^2, are obtained for the charge and current densities which, according to positron theory, are induced *in vacuo* by an electromagnetic field. Because the corresponding correction terms in the Maxwell field equations involve integral operators, it does not seem possible to treat the modified field equations by Hamiltonian methods. [See following Abstract.] AUTHOR.

3666. Polarisation Effects in the Positron Theory. E. A. Uehling. *Phys. Rev.* 48. *pp.* 55–63, *July* 1, 1935.—Some of the consequences of the positron theory for the special case of impressed electrostatic fields are investigated. By imposing a restriction only on the maximum value of the field intensity, which must always be assumed much smaller than a certain critical value, but with no restrictions on the variation of this intensity, a formula for the charge induced by a charge distribution is obtained. The existence of an induced charge corresponds to a polarisation of the vacuum, and as a consequence, to deviations from Coulomb's law for the mutual potential energy of point charges. Consequences of these deviations which are investigated are the departures from the Coulombian scattering law for heavy particles and the displacement in the energy levels for atomic electrons moving in the field of the nucleus. [See preceding Abstract.] AUTHOR.

3667. Gyromagnetic Effect of Ferromagnetic Compounds. D. P. R. Chaudhuri. *Indian Journ. Phys.* 9. *pp.* 383–414, *May*, 1935. —The ratio of angular momentum to magnetic moment of the elementary carriers of ferromagnetism, in a number of ferrites is determined by the resonance method due to Einstein and de Haas. The "*g*" value (Landé factor) falls below the orthodox value of 2 for all cases by about 3 % which is outside the limits of experimental error. The result may be explained on the assumption that the *l*-moment also contributes to ferromagnetism. AUTHOR.

***3668. Galvanometer Constant of a Circular Coil of Many Windings. R. T. Glazebrook.** *Roy. Soc., Proc.* 150*A*. *pp.* 487–494, *July* 1, 1935.—The galvanometer constant of a circular coil of many turns wound in several layers in a space of dimensions fairly small compared with the radius of the coil, is found by determining the field due to each turn of wire, and summing—not integrating—the results for all the turns of the coil. The galvanometer constant is slightly different—by a few parts in a million—when the turns of wire lie in circles at right angles to the axis, and when they form a single closely wound helix. There is therefore some uncertainty due to want of an exact knowledge of the path of the current, and this emphasises the importance of using wherever possible single-layer coils with the wire wound in helical grooves, as suggested by Viriamu Jones. P. V.

***3669. H.F. Thermo-Gaussmeters and Thermo-Ammeters. M. Laporte and V. Vasilesco.** *J. de Physique et le Radium*, 6. *pp.* 289–294, *July*, 1935.—The maximum intensity of a h.f. sinusoidal magnetic field may be deduced from a measurement of the maximum e.m.f. induced in a search-coil placed in it. H.f. currents may be similarly measured if the ratio H/I is determined with d.c. This method of measurement is used to calibrate a simple direct-reading arrangement for measuring h.f. fields or currents, consisting of a bulb thermometer or thermojunction placed in the field, which experiences a temperature rise due to eddy-currents and, in some cases, hysteresis. At a given frequency the temperature rise produced is a measure of the field-strength and hence of the current. The sensitivity may be considerably increased by surrounding the thermometer bulb with copper or iron gauze. C. E. W.

3670. Electrical and Thermal Phenomena Related to Elastic or Plastic Deformation. A. Perrier. *Helv. Phys. Acta*, 8. 4. *pp.* 329–332, 1935. *In French.*—The relations between mechanical deformation and magnetisation (caused either by electric currents or heat) are already known but these relations in the case of the simultaneous application of mechanical constraints (other than uniform pressure) and potential or thermal gradients have not been studied closely. The thermal and electrical effects observed in a deformed rod are briefly tabulated and two new effects are suggested; attempts are being made to examine these experimentally. H. J. H. S.

See also Abstracts **3294**, **3307**, **3308**, **3323**, **3611**, **3649**, **3654**.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***3671. Electrical Instruments for Biological and Medical Purposes. B. H. C. Matthews.** *Journ. Sci. Instruments*, 12. *pp.* 209–214, *July*, 1935.—The instruments used in biology and medicine may be subdivided into three groups: (*a*) for use in respect to non-electrical phenomena, *i.e.*, measurement of light and temperature, etc., (*b*) to measure electrical characteristics of living tissues, (*c*) to record potentials produced by living tissues. These applications exclude X-ray and diathermy apparatus. In group (*a*) the simple thermocouple has been developed to measure temperatures of the order of 10^{-7}°C. There are applications of the photo-cell to measure chemical changes in fluids such as blood and, recently, a piezoelectric myograph has been developed. In group (*b*) Hill has applied electrical instruments to produce the rise and fall of electrical stimuli in a predetermined manner by control of the light upon a photo-cell by sector shutters. In group (*c*) the kathode-ray oscillograph, Matthews moving-iron oscillograph and the Duddell moving-loop oscillograph find application. A new inductor oscillograph due to Shire is described in detail with connections, as well as the applications of the above oscillographs, that of Duddell being restricted owing to its low current sensitivity. The author is of opinion that the instruments available are sufficient to extend biological research in very many directions. Photographic recording is a hindrance and the author has designed a moving-iron ink-writing oscillograph which has definite advantages. In recent years portable electrocardiographs and the author's ink-writing type have been introduced. B. J. L.

3672. Ultra Short-Wave Therapy. E. Schliephake. *J. de Radiologie et d'Électrologie*, 19. *pp.* 274–281, *June*, 1935.—The use of short-wave oscillations below 15 m. is considered by Schliephake to result in a specific effect. In respect to the production of heat this is a Joule effect, but it is claimed there is also a selective effect, which the author bases upon research upon electrolytes. It is stated that the surface tension of liquids within the living body is changed by ultra short-wave radiation, with resulting biological effects. The biological responses are stated to be as distinct for ordinary diathermy and ultra short-wave therapy, as the biological responses to X-rays and ultra-violet rays. The technique of application is briefly discussed and the conditions which benefit from the use of short-wave therapy are discussed to greater length. The author considers the action is directly upon the bacteria causing disease and the tissue resistance towards bacteria is also increased. In a note appended **L. Delherm and H. Fischgold** consider there are no physical, technical, or biological grounds for assuming a specific action of ultra short-wave therapy and that the effect of electromagnetic waves below 10 m. is simply electrical and in no manner biological. B. J. L.

3673. Excito-Motive Currents for Therapeutic Purposes. A. Laquerrière. *J. de Radiologie et d'Électrologie,* 19. *pp.* 282–285, *June,* 1935.—A discussion in respect to priority, of the use of capacitative electrical currents for therapeutic purposes. Such use was first proposed by d'Arsonval in 1891. Further use was by the author and Bergonié and, in 1907, by Bordet. In 1915 Lapique without knowledge of the work of Bordet utilised such progressive capacitative currents and, independently, Belot utilised similar current which the author defines as a galvanic (direct) current which progressively increases in intensity, remains constant for a certain time, then declines to zero and is repeated in an inverse manner. An apparatus employing these currents was developed by Delherm and the author in 1931. The author submits that "progressive currents" are only a modification of an undulatory current and have only an excito-motive action which does not provoke strong muscular reaction.

B. J. L.

3674. Deep Effect and Localisation in the Short-Wave Condenser Field. F. Nagelschmidt. *Brit. J. of Radiology,* 8. *pp.* 449–456, *July,* 1935.—Any object introduced into the condenser field deforms it. This and the radiation of the short-wave condenser makes an exact dosage illusionary. It is shown that dielectrics or semi-conductors, like, *e.g.*, electrolytes, body-tissue or limbs, do not deform the field indiscriminately, but refract the lines of force. With a suitable choice of the relation of the surfaces of the electrodes to the cross-section of the dielectric (a glass tube with the white of an egg) and with the right relation of length to cross-section, a selective heating takes place in the middle of the object on account of the additional lines of force entering along the tube. Objects the size and form of which do not correspond to these conditions can be suitably adapted by applying auxiliary electrodes. Wax-paraffin mixtures or agar with certain admixtures are suitable materials. In this way an exact localisation of the heating and a considerable heating effect may be produced. AUTHOR.

3675. Speedier Production of the Finished Radiograph. A. E. Barclay. *Brit. J. of Radiology,* 8. *pp.* 373–382; *Disc.,* 382–384, *June,* 1935.—Development and fixing times being only variable within narrow limits, attention is paid to washing and drying processes. An investigation into washing was carried out by testing the water for hyposulphite using either the $KMnO_4$ or iodine tests. By using a battery of washing tanks so constructed that nearly-washed films were not contaminated by films having hyposulphite adhering, it was found the adequate washing could be completed in 4 min. With regard to drying, it was found that a considerable saving of time could be effected by removing surplus water with a squeegee and drying in a current of hot air. Using these methods films can be processed and dried in about 15 min. G. E. B.

3676. Evaluation of Ultra-Violet Radiation in Absolute Units. W. W. Coblentz. *Am. J. of Roentgenology and Radium Therapy,* 33. *pp.* 793–800, *June,* 1935.—At the second International Light Conference at Copenhagen in 1932 it was shown that the valuation of ultra-violet light for therapeutic purposes should be based upon physical factors which are reproducible. Whilst photo-biological reactions must necessarily receive due consideration, in spite of the defects of photochemical and photoelectric methods of measurement, the physical method is the method of election and the relation of biological and physical values must depend on future research, the subject at the moment being of a very open nature. The author suggests the use of three standard filters and the use of three standard spectral bands of irradiation, namely, band A, from 4000 to 3150 Å, band B, from 3150 to 2800 Å, and C, wave-lengths shorter than 2800 Å, which are considered to represent the germicidal, the antirachitic and erythemal and the deeply penetrating ultra-violet radiations respectively. To evaluate these three spectral bands by means of absorption the author proposes the use of Noviol-A yellow glass of thickness 1·49 to 1·51 mm., Barium-flint glass thickness 3·10 mm. and Corning Pyrex glass thickness 1·99 to 2·01 mm. as standard filters A, B, and C. The accuracy of the method is discussed after values of absorption are given. It is stated that the lamps of responsible manufacturers generally radiate a suitable radiation, but many cheap lamps emit little, or no ultra-violet radiation. B. J. L.

3677. X-Ray Protection. Part V. E. I. L. Cilley, E. T. Leddy and B. R. Kirklin. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 787–792, *June*, 1935.—Continues detailed investigations of the amounts of radiation absorbed by the radiologist during certain technical procedures of medical X-ray examination, particularly with respect to palpation procedures that in respect to stomach palpation having been dealt with [see Abstract 2761 (1935)], and the present paper deals with palpation during X-ray examination of the colon. The actual amount of radiation received is a multiple of the so-termed tolerance dose, but has been incurred by various operators over lengthy periods of years with apparent impunity. Importance is placed upon the speed of examination, the protective power of the barium salt employed and the use of as small a field of irradiation as possible. Ionisation methods and photographic methods of measurement of the doses received cannot be reconciled, but the authors are of opinion that the present methods of examination are adequate in respect to protection of the operator. B. J. L.

3678. Homogenisation and Mean Wave-Length in Deep X-Ray Therapy. Baque, Bugnard and Marquès. *J. de Radiologie et d'Électrologie*, 19. *pp.* 286–293, *June*, 1935.—A discussion on logarithmic curves of absorption of X-rays by metals with reference to the use of metallic filters in X-ray therapy and the relative variations with constant, pulsatory and intermittent electrical excitation of the X-ray tube. The absorption is dependent upon the method of excitation, since this modifies the quality of the X-ray radiation. The absorption curves are easily obtained in normal clinical practice and a semi-logarithmic curve is particularly suitable, the thickness of filter which permits the most useful homogeneous radiation being denoted by change of the absorption curve direction and, from this, the mean wave-length of the radiation is easily determined. Filtration with 0·12 cm. of Cu or 1·4 cm. of Al is most advantageous between 110 and 180 kV. Filtration by Cu is superior to filtration by Al, the resulting homogeneous radiation having a lower wave-length in the case of Cu. For the same applied voltage and the same filtration, constant-tension apparatus, for the same homogeneity, gives a more penetrative radiation than is obtained with pulsating current, which in turn is superior to the intermittent induction coil voltage. For pulsating and intermittent voltages a filtration by 0·12 cm. copper is satisfactory. B. J. L.

3679. Quality of H.V. Radiations. W. V. Mayneord and J. E. Roberts. *Brit. J. of Radiology,* 8. *pp.* 341–362; *Disc.,* 362–364, *June,* 1935.—The main methods of defining the quality of an X-ray beam, namely the equivalent constant voltage, effective wave-length and half-value layer are discussed and it is concluded that the specification of the half-value layer is least open to criticism. The question of the best material in which to specify the half-value layer is gone into and experimental results are given which show that for h.v. radiations tin is perhaps the most satisfactory metal. Lead is considered unsuitable on account of its characteristic radiations. Combinations of metals are discussed and suggestions made for practical filters. G. E. B.

3680. Dosage and Intensity Distribution in Radium Teletherapy. H. T. Flint and C. W. Wilson. *Brit. J. of Radiology,* 8. *pp.* 426–438, *July,* 1935.—The results are given of a series of water phantom measurements, by Sievert's condenser chamber method, on the intensity distributions of the 2 gm. radium bomb in use at the Westminster Hospital Annexe, London. The best thickness of secondary copper filter is discussed and results are given that show " back-scatter " at the surface to be negligible for this particular unit. The results for the measurement of doses for various radium-skin distances are expressed graphically. The expression of therapeutic doses in r units is discussed, and the skin erythema dose in r, thus found, is compared with values given by other workers.

AUTHORS.

See also Abstract 3332.

OSCILLATIONS.

***3681. A.C. Operated Beat-Frequency Oscillator. G. P. Harnwell and S. N. van Voorhis.** *Rev. Sci. Instruments,* 6. *pp.* 194–195, *July,* 1935.—An a.c. operated beat-frequency oscillator constructed from ordinary radio parts is described. The circuit design gives good wave form, and excellent stability of frequency with changing line voltage.

AUTHORS.

***3682. Floating-Grid D.C. Amplifier. P. A. Macdonald and E. M. Campbell.** *Physics,* 6. *pp.* 211–214, *July,* 1935.—It is shown that commercial screen-grid valves are suitable for high sensitivity d.c. amplifiers. The theoretical limit due to the Johnson effect has been observed and agrees with the calculated value. Tubes when operated at floating grid are capable of detecting 2×10^{-16} ampere, the theoretical limit of the tube. Absolute linearity of response exists at least up to currents of 2×10^{-12} ampere. AUTHORS.

3683. Valve Electronics. C. J. Bakker and G. de Vries. *Physica,* 2. *pp.* 683–697, *July,* 1935.—The effect of the transit time of the electrons ought to be taken into account for a description of the performance of valves at high frequencies. In this paper experiments on this subject are described. Theoretical considerations are given. The agreement of the experimental and theoretical results is satisfactory. AUTHORS.

See also Abstract 3602.

PHOTOELECTRICITY.

3684. Photo-E.M.F. in Cuprite Crystals. Anne Joffé and A. F. Joffé. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 343–365, 1935. *In English.*—The diffusion theory of the photo-e.m.f. appearing in cuprous oxide crystals during illumination does not agree with experimental data.

The investigation of the potential distribution on such a crystal leads to the assumption of a steady flow of electrons from the illuminated area in all directions. This flow is compensated for by a conductivity current. A new formula for the p.d. is derived, which is in good agreement with experimental dependence on temperature and light intensity. The diffusion formula of Teichmann [see Abstract 1354 (1934)] could be regarded as an approximation valid for low electron concentrations. AUTHORS.

3685. Direct Effect of Light upon the Electrical Resistance of Metals. A. Etzrodt. *Phys. Zeits.* 36. *pp.* 433–441, *June* 15, 1935.—In a previous paper [see Abstract 3251 (1933)] the author has criticised the conclusions of Majorana concerning the increase of resistance of certain metals produced by the action of light. Whereas Majorana considers this to be due to an anomalous photo-effect with a thermo-effect superimposed, the author now adduces further experimental evidence that the effect is entirely a thermo-effect. Experiments are carried out upon Bi single crystals and constantan, the conditions being varied so that the thermo-effect becomes zero. The whole effect of the light is then observed to vanish, so that a pure photo-effect causing increase of electrical resistance is excluded. L. A. W.

***3686. Cadmium-Magnesium Alloy Photoelectric Cells. L. R. Koller and A. H. Taylor.** *J.O.S.A.* 25. *p.* 184, *June*, 1935.—Spectral sensitivity data are given for cells with kathodes of Cd-Mg alloys in corex glass bulbs. The response curve shifts towards longer wave-lengths as the proportion of Mg increases. D. H. F.

***3687. Quantum Efficiency of Light-Sensitive Devices. C. C. Hein.** *J.O.S.A.* 25. *pp.* 203–206, *July*, 1935.—Quantum efficiency of a light-sensitive device is defined as the number of electrons released per unit incident quantum. Values of efficiencies are obtained from spectral response curves plotted in absolute values. The necessity of absolute values requires the use of a calibrated thermopile. The calibration of the thermopile and the method for obtaining spectral response curves are described. Curves are plotted for the visible region giving the maximum theoretical yield and also the yield and quantum efficiency for two types of Photox, two types of selenium photovoltaic units, a cæsium oxide photo-cell and the thermopile. The maximum yield for photovoltaic units is found to range from 0·045 to 0·125 ampere per watt with a quantum efficiency range of from 9 to 28 %. The maximum visible yield of the cæsium oxide surface is 0·002 ampere per watt and a quantum efficiency of 0·4 %, while the thermopile yield is 0·022 ampere per watt with an efficiency of 5 %. AUTHOR.

***3688. Spectral Sensitivity of the Aachen Photoelectric Cell. O. Hoelper and J. Werner.** *Gerlands. Beitr. z. Geophys.* 44. 3. *pp.* 236–265, 1935.—The distribution of sensitivity in the spectral curves of three cadmium cells and one potassium cell is obtained by a thermopile and a quartz-mercury-vapour lamp. In addition the distribution in two of the cells is obtained from the calculated terrestrial energy for long waves. The curve obtained by this method for a cadmium cell is verified by comparison of the integral $\int \phi d\lambda$, the resultant of currents from the solar spectrum, with the total currents measured at different heights of the sun. The application of these cells to meteorological observations is discussed and the daily change of the ultra-violet solar spectrum is indicated for one of the cells. H. M. B.

***3689. Photoelectric Cells. W. Kluge.** *Zeits. f. techn. Physik*, 16. 7. *pp.* 184–193, 1935.—Progress review.

3690. Photovoltaic Effect with Grignard Reagents. J. Harty. *J. Phys. Chem.* 39. *pp.* 355–369, *March*, 1935.—A study was made of the effects of adding EtBr and EtI, as depolarisers, to photovoltaic cells in which solutions of EtMgBr in ether and of PhMgBr in ether were used as electrolytes and Cu, Zn, Al, Fe, Pb, and Pt were used as electrodes. A large number of observations, in the dark and under illumination, were made of the voltage, current strength with and without the application of external voltage, resistance and capacitance. The results are considered to be in accord with the theory that the photovoltaic effect is due to the effect of excited molecules on or near the electrode. D. H. F.

***3691. Photoelectric Effect of Blocking Layer. R. Deaglio.** *Accad. Sci. Torino, Atti*, 70. 2. *pp.* 272–275, 1934–1935.—Results are given of the rectification of a cell made of silver and a monocrystal of Cu_2O with a blocking layer. The method of producing the layer of about 10^{-6} cm. is described. Rectification occurs such that the passage of electrons from the metal to those from the semi-conductor is in the ratio 50 : 1, but no photoelectric effect is seen. The same effect is noticeable for a cell of gold and platinum : thus it appears that the photoelectric effect is not necessarily present in a blocking-layer cell. H. M. B.

***3692. Frequency Response of Rectifier Photoelectric Cells. A. Bloch.** *Rev. Sci. Instruments* 6. *p.* 173, *June*, 1935.—Points out that J. H. Roe, in his investigation of this matter [see Abstract 917 (1935)] did not use a sine curve of illumination. The author describes two methods by which such an illumination/time curve may be obtained. J. W. T. W.

See also Abstracts **3610, 3634.**

PIEZOELECTRICITY.

***3693. Preparation and Mounting of Rochelle Salt Specimens. H. Körner.** *Zeits. f. Physik*, 94. 11–12, *pp.* 801–807, *May* 3, 1935.—An account is given of the methods to be adopted for the preparation and mounting of Rochelle salt specimens in order to obtain reproducible piezoelectric properties. The principal points of importance are the attachment of the electrodes and the maintenance of a constant degree of dryness. A description is given of apparatus whereby the practical difficulties are overcome and of test measurements proving its efficiency. L. A. W.

3694. Stabilisation of Beat Frequency by Temperature-Coefficient Compensation. A. de Gramont and D. Beretzki. *Comptes Rendus*, 200. *pp.* 1558–1560, *May* 6, 1935.—A master oscillator of frequency practically independent of reaction and of temperature was constructed from two quartz oscillators of high frequencies f and f', beating at the desired frequency. The desired beat frequency $f-f'$ is independent of temperature when f_0K is equal to f_0'K′, where f_0 and f_0' are the frequencies of the two quartz oscillators at 0° C., and K and K′ their temperature coefficients. By this method it was found possible to obtain beat frequencies constant to 1 part in a million over a temperature interval of 50° C. As the oscillations are due to beats, their frequency is not affected by reaction at the beat frequency. P. V.

3695. Diffraction Effects with Oscillating Crystals. C. Schaefer, L. Bergmann, E. Fues and H. Ludloff. *Preuss. Akad. Wiss., Berlin, Ber.* 14. *pp.* 222–239, 1935.—Previous papers [see Abstracts 242 and 515

(1935)] have described the diffraction patterns obtained with quartz, glass, etc., in a state of h.f. oscillation. Experiments have been carried out with calcspar, tourmaline, beryl, topaz, heavy spar, zinc blende, fluorspar, etc. The first part of this paper (by Schaefer and Bergmann) gives an account of the results obtained with heavy spar. In the second part (by Fues and Ludloff) a theory of the phenomena in question is presented and it is shown that the experimental results for quartz and for heavy spar are in good agreement with theory. A. W.

3696. Vibratory Modes of Oscillating Quartz. L. Brüninghaus. *J. de Physique et le Radium*, 6. *pp.* 159–167, *April*, 1935.—The modes of vibration of the crystal are examined by means of an optical system embodying a second similar crystal and crossed nicols so disposed that interference fringes result from the variations in double refraction at the nodes and antinodes. The range of frequencies obtainable from one or other of 4 plates vibrating in different modes was from 694,000 to 1,154,000 ∼ and it is shown that the various figures result from the combination of two (or occasionally three) rectangular vibrations. G. E. B.

3697. Length Oscillations of Circular Quartz Plates. V. Petržilka. *Ann. d. Physik*, 23. 2. *pp.* 156–168, *June*, 1935.—The quartz plates used were cut perpendicular to the optic axis. According to Love's theory of elasticity three types of oscillations are possible with plates such as were used, one in the direction of the radius (type A), a second in a direction perpendicular to the radius (type B), and a third (type C) which is a combination of the first two. For the order $n = 0$ in Love's theory, types A and B may be produced. Experimental results were in this case found to be in good agreement with theory. For orders of $n > 0$ oscillations of the third type (type C) may be obtained. For $n = 1$ and $n = 2$ good agreement was obtained between the calculated and observed frequencies. For higher values of n the nodal lines are very complex, rendering comparison with theory difficult. Oscillations of types A and B have three axes of symmetry, which correspond with the electric axes. These oscillations were used to determine the modulus of elasticity (E) and Poisson's constant (σ). The values found for E ranged from $7 \cdot 876$ to $8 \cdot 047$, while σ was found to have a value in the neighbourhood of $0 \cdot 13$. A. W.

3698. Electrodynamic Characteristics of the Quartz Piezoelectric Oscillator. J. W. Speight. *Canad. J. of Research*, 12. *pp.* 812–824, *June*, 1935.—The electro-acoustic properties of a piezoelectric oscillator in the form of a quartz-steel sandwich have been studied. The oscillator is assumed to be perfectly efficient and to be emitting divergent waves into the medium in which it is immersed. The arrangement of quartz to steel is investigated with a view to obtaining the best operating conditions of the oscillator. When the radius of the oscillator is infinite, the results reduce to those obtained when plane waves are emitted into the outside medium. [See Abstract 5153 (1934).] AUTHOR.

3699. Theory of Two-Dimensional Longitudinal and Flexural Vibrations in Rectangular Isotropic Plates. Longitudinal, Shear and Transverse Modes of Vibration in Quartz and Tourmaline. H. Osterberg and J. W. Cookson. *Physics*, 6. *pp.* 234–256, *July*, 1935.—The differential equations of a free, rectangular isotropic plate are solved for the longitudinal and flexural cases in which, using cartesian coordinates, no displacement occurs along the z-direction. In the longitudinal case, only the odd harmonics of both the modes in which the trains are propagated along X and Y form a mechanically-coupled system, while only the even harmonics do so in the flexural case. The mathematics is extended to determine the coupling between longitudinal and flexural modes. In the second paper, theory combined with experiment shows that the displacements are most nearly pure (*i.e.*, limited to the direction of propagation) in rectangular plates whose greatest dimension is that along which the compressional wave-trains are propagated. In quartz the patterns are so complicated, that the correspondence is open to doubt, but are purer in tourmaline. In a large variety of quartz no free simple shear modes are seen and there is no evidence of transverse vibrations. Crystals of β-quartz are active oscillators even at 800° C. H. M. B.

THERMIONICS.

3700. Theory of the Thermionic Constants for Pure Metals. D. Blochinzew and S. Drabkina. *Phys. Zeits. d. Sowjetunion,* 7. 4. *pp.* 484–500, 1935. *In German.*—The Richardson constant A is shown not to be universal but to depend on the kind of metal and a relationship is obtained between A and A_0. For alkali metals A depends only on the relation of work function and temperature but for metals with intense inner fields, the penetration factor D and the ratio of the " effective " mass of the electron to the mass of the free electron also plays a part, *i.e.*, the wave number and the diffraction effects of the metal surface are of importance. H. M. B.

3701. Theory of Work Functions of Monovalent Metals. E. Wigner and J. Bardeen. *Phys. Rev.* 48. *pp.* 84–87, *July* 1, 1935.—The work function is defined as the difference in energy between a lattice with an equal number of ions and electrons, and the lattice with the same number of ions, but with one electron removed. The work function is then found by first calculating the energy of a lattice with n_i ions and n_e electrons. The final formula gives the work functions of monovalent metals in terms of the heats of sublimation. This formula is approximate, and can claim validity only in a qualitative way, as one of the important factors, the electric double layer on the surface, is omitted entirely, and it is assumed that the Fermi energy is as great as if the electrons were entirely free. The values obtained from this formula check very closely with the experimental values for the alkalis, so that it can be concluded that the double layer is probably small for these metals. Finally, the deviations to be expected for other than monovalent metals are considered. AUTHORS.

3702. Cooling Method of Estimating the Heat of Vaporisation of Electrons and their Temperature-Coefficients for Glowing Wires of Mo, W and Ta. F. Krüger and G. Stabenow. *Ann. d. Physik,* 22. 8. *pp.* 713–734, *May,* 1935.—The work function of electrons in leaving glowing metals is measured by compensating the cooling due to the emission of electrons by raising the heating current and measuring this compensating current by a resistance in an a.c. Wheatstone bridge circuit using blocking coils and condensers. The work function can be obtained to a fraction of 1 %, and thus for Ta and W the temperature-coefficient is also found ; for Mo the temperature change is too small to give this coefficient. The results, when extrapolated to absolute zero, agree well with other methods of determination. The positive temperature-coefficients are lower than the theoretical value, for the constants of the Richardson equation. H. M. B.

∗3703. Distribution of Emission over a Crystalline Heated Kathode. D. Schenk. *Ann. d. Physik,* 23. 3. *pp.* 240–254, *June,* 1935.—A description is given of an electron microscope with a collecting cage mounted behind a small hole in the centre of the screen. By means of this device it is possible to measure the emission from the particular small kathode region corresponding to the collecting aperture. The region investigated can be varied by magnetic deflection of the whole electron image. In this way measurements are made upon the distribution of intensity of electron emission over the surface of a nickel kathode sensitised with Ba. The individual elements taken have an area of 5×10^{-5} sq. cm. By means of a registering device, the behaviour of which is discussed, the distribution of emission along a diameter of the above kathode is recorded and compared with the photographically revealed structure. Observed differences in the emission from different crystallites in the ratio 1 : 6 are explained (in agreement with photoelectric investigations upon single crystals) as due to differences of 0·2 V in the work function. L. A. W.

See also Abstracts 3202, 3647.

THERMOELECTRICITY.

3704. Thermo-E.M.F. of Solid and Liquid Alkali Metals Against Platinum. E. Heiber. *Ann. d. Physik,* 23. 2. *pp.* 111–136, *June,* 1935.—The thermo-e.m.f. against Pt of Li, Na, K, Rb and Cs in the solid and (except Li) liquid states, was measured with the utmost accuracy for both rising and falling temperatures of the hot junction. Special attention was paid to the purity of the metals. The results obtained are in general agreement with those of earlier experimenters and confirm the existence of discontinuities at the melting points in the curves connecting thermo-e.m.f. with temperature and abrupt jumps, differing in amount with the different metals, in the curves connecting thermoelectric power with temperature. In conclusion the author shows that the existence of these discontinuities is not inconsistent with a satisfactory theory of thermo-e.m.f. It may be construed to signify that the heat of transition of the electrons in the electron vapour space at the melting point is less for the liquid than for the solid phase. T. I. J.

3705. Direct Measurement of the Peltier Coefficient. A. J. Woodall. *Phys. Soc., Proc.* 47. *pp.* 615–625, *July* 1, 1935.—The fundamental problems in the direct measurement of the Peltier coefficient are discussed with reference to the various methods available. A new apparatus is described which includes all-metal calorimeters, separate from the specimens, and a differential platinum-resistance thermometer. With a sufficiently good thermostat this would just detect a steady heating of the order of 10^{-7} cal./sec. The high sensitivity of this arrangement has permitted a strict test of the proportionality of the Peltier effect to current to be carried down to 0·012 A, with copper-constantan junctions. The error due to thermal losses along the leads has been especially studied, and estimates of the loss have been made. AUTHOR.

See also Abstract 3624.